ELM CONSULTING, L.L.C.

Memo

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From: Jody Kubitz, ELM Consulting

CC: Jim Lanzafame, The Doe Run Company
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Date: 12/01/00

Re: Screening-Level Ecological Benchmarks

Attached is ELM Consulting's working inventory of screening-level ecological benchmark concentrations. This inventory was last updated about a year ago, and does not include specific numbers from the MacDonald, Ingersoll and Berger paper. I worked with Chris Ingersoll during the USEPA's development of standard sediment toxicity test methods, and am familiar with MacDonald's work on sediment guidelines for the State of Florida in the mid-1990s. The approaches they have been using to develop guidelines are nearly identical to those used by Long & Morgan of the National Oceanic and Atmospheric Administration (NOAA) to develop the effects range-low (ERL) and effects range-median (ERM) values. The attached materials include the NOAA ERLs. I will evaluate the MacDonald-Ingersoll-Berger values and add them to the list of benchmarks if they are different from the ERLs.

These benchmarks are candidate values for use in selection of constituents of potential concern (COPCs) in step 2 of Ecological Risk Assessment. These benchmarks might also have applications in the Preassessment Screen. In general, exceeding a screening-level benchmark does not prove there is an ecological risk or that injury to natural resources has occurred. However, if the concentration for a specific constituent in all site samples is less than the most conservative benchmark, then that constituent can confidently be eliminated as a COPC early in the investigation. The proposed use of these benchmarks for the Slag Pile Investigation will be provided in the upcoming Work Plans. If there are additional benchmarks that you would like to include in this site investigation, please send me a copy of the source, or email the reference to me (jkubitz@elmllc.com).

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Appendix G

SUMMARY OF SCREENING-LEVEL ECOLOGICAL BENCHMARKS TO BE USED FOR THIS STUDY.

G- 1.0 INTRODUCTION

This appendix contains descriptions of the various water, sediment, and soil quality benchmarks that will be considered in the selection of the screening-level ecological risk-based concentrations (E-RBCs). The E-RBCs will be compared to the upper 95% confidence limit of the mean concentration (95% UCL) of constituents that are detected within the study area in the screening-level ecological risk assessment (SL-ERA). These comparisons will be made to determine if the observed constituent concentrations could pose risks to ecological receptors under conservative exposure scenarios. The comparisons of 95% UCLs to E-RBCs, in conjunction with comparisons of site and reference data, will be used to determine which of the substances detected in the RI/FS will be constituents of potential concern (COPCs) for this screening-level ecological risk assessment.

Numeric (concentration-based) benchmarks and criteria for the protection of ecological receptors have been published by several national and state government agencies. These numeric criteria and benchmarks are not available for all compounds or elements, nor are values available for all environmental media. The numeric values that are available for water are summarized in Tables G-5 to G-7 and G-14, the numeric sediment values are summarized in Tables G-8 to G-10 and G-15, and the numeric soil values are summarized in Tables G-11 to G-13 and G-16. In several cases, there is a relatively wide disparity among agency values for the same constituent in the same matrix. These disparities are caused, in some cases, by differences in the methods used to interpret toxicological data among different government agencies. In other cases the differences in values may have been influenced by data that were available when the values were published; subsequent toxicity tests may have revealed that a particular compound was more, (or less) toxic.

Another factor potentially responsible for this disparity, may be differences in the number and types of biological species (taxa) that were used to derive the benchmarks. A common method for developing ecological benchmarks depends on the results from toxicity test conducted on many species. The ecological criterion is then selected as the concentration at which a measurable change in the most sensitive species was observed. If enough taxa have been tested for a chemical, typically 3 or more, then statistical techniques are employed. The result is a criterion that is statistically based, not biologically, that will protect a known percentile of the species used in the studies and theoretically nature. This approach provides the most conservative method for estimating adverse responses in nature.

Other approaches may use a single species, genus, or family to derive a criterion. Under this scenario, typically advanced statistical and modeling approaches are employed that increase the environmental relativity of the benchmarks based on either known

characteristics of the chemical or the biological population of concern. Examples of these benchmarks are illustrated by the U. S. EPA Office of Research and Development's ΣPAH Mixture LC50 benchmarks for sediments and Oak Ridge Risk Assessment Program's Population EC20 benchmarks for surface water, respectively. These are discussed in the following sections.

Regardless of the discrepancies in ecological benchmarks, the most conservative (smallest) values will be selected for the E-RBCs during the screening-level ecological risk assessment. This approach allows us to assess ecological risk with very conservative estimates, incorporating the most sensitive exposure route and biological receptor.

In some cases, published models have been used to calculate E-RBCs. In these cases, an ELM ecotoxicologist calculated an E-RBC using scientifically valid and accepted methods. For organic compounds, these methods included application of quantitative structure-activity relationships to develop E-RBCs for water (Van Leeuwen et al., 1992), and equilibrium partitioning theory to develop E-RBCs for sediments (USEPA, 1993a-d; Van Leeuwen et al., 1992; Swartz, 1999). The data used to calculate these E-RBCs are presented in tabular form in this appendix.

G - 2.0 ECOLOGICAL BENCHMARKS FOR EXPOSURES TO GROUNDWATER AND SURFACE WATER

The available water quality criteria and benchmarks for the protection of aquatic life were reviewed and summarized in Tables G-5 to G-7 and G-14. Sources of the criteria and benchmarks with a description of the taxonomic breadth applicable to each, if available, are listed below:

- U.S. Environmental Protection Agency (USEPA):
    - Criterion Continuos Concentration (CCC: results from eight separate toxicity tests representing the responses of at least at least eight families of aquatic biota);
    - Final Chronic Value (FCV: results from at least three separate toxicity tests representing the responses of at least three families of aquatic biota); and
    - Lowest Chronic Value (LCV: results from one chronic toxicity study representing the responses of one species).
- U. S. EPA Great Lakes Water Quality Initiative Tier II Secondary Chronic Values (SCV: results from at least three separate toxicity tests representing the responses of at least three families of aquatic biota);
- Canadian Water Quality Guidelines for the protection of Freshwater Aquatic Life (EQG);

- No-Effect Levels derived using the approach published by the government of the Netherlands (NELs: results from 19 aquatic species, covering prokaryotes, eukaryotes, invertebrates, and/or vertebrates); and
- Oak Ridge Toxicological Benchmarks for Effects on Aquatic Biota (Population EC20: results from largemouth bass, only);

The available benchmarks are described briefly below.

G-2.1 U. S. EPA Continuous Concentration Criteria

The USEPA (U. S. EPA, 1999b) has published Continuous Concentration Criteria (CCC) for protecting aquatic life from chronic effects (Table G-7). These values represent the current National Recommended Water Quality Criteria. The CCC values are based on toxicity testing, and for some elements, CCCs for a specific water body are based on the hardness of the receiving surface water. The criteria are based on the results from eight separate toxicity tests representing the responses of at least at least eight families of aquatic biota. The toxicity of certain divalent metals is reduced by the presence of other cations such as Ca^{+2} and Mg^{+2}. The equation used to calculate the hardness-adjusted CCC is described below:

$$CCC = e^{\{m*[\ln(\text{hardness})]+b\}} \quad (1)$$

The hardness-adjusted CCC estimates the dissolved concentration of a metal. In other words, the concentration of the bioavailable fraction. The CCC represents the concentration at which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The element-specific factors used in Equation 1 are listed in Table G-1.

Table G-1. Factors used for calculating site-specific metals criteria for water.

Metal	Conversion Factors for Dissolved Metals [1]CCC	Parameters for hardness dependent dissolved metals criteria [2]m_C	[2]b_C
Arsenic	1	NA	NA
Cadmium	0.909	0.785	-2.72
Chromium III	0.860	0.819	0.685
Copper	0.960	0.855	-1.70
Lead	0.791	1.27	-4.71
Mercury	0.850	NA	NA
Nickel	0.997	0.846	0.0584
Silver	NA	NA	NA
Zinc	0.986	0.847	0.884

[1]Appendix A of National Recommended Water Quality Criteria-Correction (U. S. EPA, 1999b)
[2]Appendix B of National Recommended Water Quality Criteria-Correction (U. S. EPA, 1999b)

G – 2.2 Oak Ridge Toxicological Benchmarks: Final Chronic Values

For compounds lacking National Recommended Water Quality Criteria, Final Chronic Values (FCVs) are presented in Tables G-5 and G-6. FCVs are tentative benchmarks used to screen potential hazards to aquatic organisms. The values presented in this appendix were compiled by Suter and Tsao (1996). This criterion is derived from Final Acute Values (FAV) which represent the fifth percentile of a population of 48 to 96 hour LC50 or EC50 values for each chemical. The FAV is then divided by the Final Acute-Chronic Ratio (FACR) to produce the FCV. The FACR is the geometric mean of at least three LC50 values divided by chronic values. Suter and Tsao's compilation have excluded FCV listed by the EPA that are protective of piscivorous wildlife and humans, and represent values solely protective to aquatic organisms. This criterion is intended to prevent toxic effects during chronic exposures.

G – 2.3 Oak Ridge Toxicological Benchmark: Lowest Chronic Values

Since many compounds lack National Recommended Water Quality Criteria and Final Chronic Values, Lowest Chronic Values (LCV) are presented in Tables G-5 to G-7 and G-14. LCVs are tentative benchmarks used to screen potential hazards to aquatic organisms. The values presented in this appendix were compiled by Suter and Tsao (1996). This criterion is used when there is insufficient data for a chemical to calculate a FCV (i.e.,

toxicity results for 3 or more families are not available), and represents the lowest value from one chronic exposure to one or more aquatic species. The LCV value for anthracene has been excluded from presentation because photoenhanced toxicity assays were used to derive the benchmarks. Photoenhanced toxicity assumes that UV-A wavelengths can travel through the water column, enter the test organism, and modify the structure of the compound. This photoactivated compound may be far more toxic than its original form. Due to the trophic status of the water bodies associated with the site, UV-A wavelengths will be readily attenuated by dissolved and suspended organic mater in the water column.

G – 2.4 Oak RidgeToxicological Benchmark: Tier II Values

The Great Lakes Water Quality Initiative (GLWQI) provides a methodology for calculating benchmarks when insufficient data are present to derive a NAWQC (U. S. EPA, 1993e). Researchers at Oak Ridge National Laboratory adopted this methodology with some modification and derived their own Tier II benchmarks. Statistically derived "adjustment factors" are used to calculate the Tier II values. The adjustment factor is the Final Acute Value Factor (FAVF). As the amount of available data increases by taxonomic representation for a specific chemical the FAVF decreases. Of the data available the lowest genus mean acute value (GMAV) is divided by the FAVF. This product is the Secondary Acute Value (SAV). Then the secondary acute to chronic ratio (SACR) is derived based on the geometric mean of at least three acute to chronic ratios from experimental results. The secondary chronic values (SCV; data presented in Tables G-5 to G-7 and G-14) are then derived by dividing the SAV or FAV, if available, by the SACR. These values are expected to be 20% higher than the NAWQC. The Tier II values presented herein are based on the values compiled in Suter and Tsao (1996). Suter and Tsao (1996) deviate from the EPA's method by calculating a SAV for chemicals that lack data for daphnia, by developing FAVFs values that are 2 to 10 times greater than FAVFs used when a daphnid is included. In the case of 1,3-dichloropropene, the SCV was derived from an assay that only employed the fathead minnow as a test organism. Therefore, a FAVF value of 242 was used. Further, a high SACR of 17.9 was used in the calculation without providing the supporting data. The resulting SCV value was excluded from the tables, because these assumptions resulted in a SCV that was over 4,000 times lower than the experimental EC50.

G - 2.5 Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life

The Canadian Environmental Quality Guidelines (EQG) for the protection of Freshwater Aquatic Life are based on interpretation of long-term no-effect concentrations (NOECs) established from chronic toxicity tests (CCME, 1999). The available Canadian guidelines have only one concentration for each compound and no site-specific environmental

variables can be used to compute values reflective of current site conditions. The guidelines are presented in Tables G-5 to G-7 of this appendix.

G - 2.6 No-Effect Levels (Netherlands Approach)

The Government of the Netherlands uses a highly quantitative approach for establishing No Effect Levels (NELs) for a variety of neutral organic compounds that have a narcotic mode of toxic action. Compounds in this class include a variety of hydrocarbons (including constituents of petroleum) and industrial solvents. A detailed description of this approach is available in peer-reviewed scientific literature (Van Leeuwen et al., 1992); the basic methodology is summarized here. There are two steps in calculating the NEL for a neutral compound in water. The QSAR step, and the HC5 step.

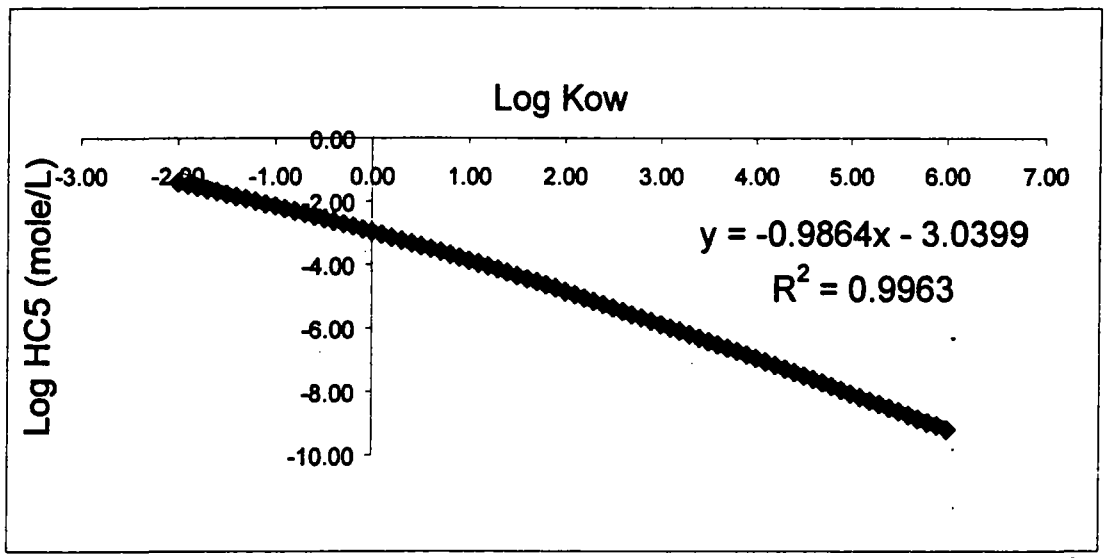
The toxicity of neutral organic (narcotic) compounds is related to water solubility, which, in turn, is characterized by the compound's octanol-water partition coefficient (K_{ow}). The relationship between toxicity and K_{ow} can therefore be described by mathematical relationships, which are called quantitative structure activity relationships, or QSARS. By measuring the relationship between the K_{ow} and NOEC of several compounds, a QSAR can be used to estimate the toxicity (NOEC) of similar compounds which have not been subjected to toxicity testing from the K_{ow} values. In the approach described by Van Leeuwen, QSARs are used to calculate the NOEC values for 19 different aquatic species. These species covered the following taxonomic groups: bacteria, algae, fungi, protozoans, coelenterares, rotifers, molluscs, crustaceans, insects, fish, and amphibians. This calculation is termed the QSAR step; then the HC5 step is performed.

Once the NOECs for a particular compound have been calculated for the 19 different species, a statistical technique is used to calculate a concentration that will protect 95% of all species from chronic (long-term) toxicity. The resulting value is referred to as an HC5 (hence, the HC5 step). Van Leeuwen et al. (1992) tested three different statistical methods for calculating HC5 values, and they chose the modified Koojiman van Straalen method (Van De Meent et al., 1990) as the best method for calculating HC5s from NOECs. For comparison, the HC5 values produced by this method are approximately equal to the lowest NOEC/10.

Following the calculation of an HC5 for each compound, NELs are calculated by applying site-specific information concerning the bioavailability (concentration of suspended sediment, and organic carbon content of suspended sediment) of these compounds in a particular water body. Because there is currently no information for calculating the bioavailability of organic compounds in the water column for our study area, the assumption was made that the HC5 concentration was 100% bioavailable, and therefore equal to the NEL. NELs (referred to as HC5s in the table) for 102 compounds are listed in Table 1 of Van Leeuwen et al. (1992). For compounds that are listed in Table 1, the NEL (dissolved water HC5s) were read directly from the table, were converted to μg/L units,

and are reported in Tables G-5 and G-6 of this appendix. For compounds that are not listed in Table 1 of Van Leeuwen et al. (1992), the NEL was determined from the compounds log K_{ow} values. For these compounds, NELs were derived by comparing their rounded Kow values to those listed in Table 6 of Van Leeuwen, and selecting the corresponding NEL (dissolved water HC5). Table 6 of Van Leeuwen provides HC5 estimates for compounds with log Kow values ranging from –2.00 to 6.00. Three of the SVOCs on our COPC list have log Kow values that exceed this range of values (6.50 to 7.66 log Kow). Therefore, a linear regression of log Kow and Dissolved HC5 values was employed to estimate HC5 values for these log Kow values that fall outside of Van Leeuwen's Table 6. Even though linear regression is intended to provide estimates from within a range of numbers, the linear relationship is so strong ($R^2 = 0.996$), that estimates provided by regression equation likely provide adequate HC5 estimates (Figure A.1). The equation and graphical representation of the linear regression is provided below:

Figure G.1. Regression of Dissolved HC5 values by Log Kow (data exerpted from Van Leeuwen et al., 1992).



For Volatile and Semi-Volatile compounds that are reported with a NEL, Table G-2 and G-3 presents a list of their Kow, Molecular Weights, Dissolved HC5 values and the corresponding reference that provided the data.

G – 2.7 Oak Ridge Toxicological Benchmarks

The Risk Assessment Program at Oak Ridge National Laboratory has developed Toxicological Benchmarks for the screening of contaminants likely found in aquatic ecosystems on the Oak Ridge Reserve (Suter and Tsao, 1996). In this document, alternative chronic benchmarks are derived for screening of ecological risks. Three benchmarks based on individual-level of effects were derived. We have chosen not to present these values, as they are similar to the U.S. EPA CCCs, CCME EQGs, and NELs in their derivation. The fourth alternative screening benchmarks predicts population-level effects for largemouth bass. This criterion predicts the environmental concentration at which a 20% reduction in recruitment occurs in a largemouth bass population. Derivation of this criterion requires both chemical- and natural population-specific data for its computation. This is unique, as all other benchmarks (water, sediment, and soil) presented herein are based on the impacts to laboratory populations that are only experiencing stress from the contaminants in a controlled environment. This model is also described in Suter (1993) and Barnthouse et al. (1990). The biological and chemical models used to produce these benchmarks are summarized below.

The biological model relies on intricate modeling and a brief discussion is presented herein. For greater description the reader is encouraged to read Suter (1993) and Barnthouse et al. (1990). The 20% reduction in largemouth populations is based on life history data of a reservoir largemouth bass population. The kernel of the population-level model is listed below:

$$R_s = (P - P_s)/P \quad (2)$$

Where,

R_s = The fractional reduction in reproductive potential;

P = The reproductive potential index in the absence of environmental stress; and

P_s = The reproductive potential index in the presence of environmental stress.

The value P is calculated with a population model that uses data which describe the probability of a female to reach reproductive maturity and the probability that her spawned egg will reach reproductive maturity. This model is modified to account for the potential impact from exposure to a contaminant through calculation of P_s. This model is described below:

$$P_s = s_o(1 - C_m)\sum_{i=1}^{n} s_i(1 - C_r)^{i-1} f_i C_f m_i \quad (3)$$

Where,

s_o = The probability that a spawned egg will hatch and survive to age 1 in the presence of a contaminant;

s_i = The annual probability for survival of a reproducing female;

f_i = The age-specific fecundity rate for the female;

m_i = The probability of a juvenile female being sexually mature;

C_m = The probability of contaminant-induced mortality during the first year of life;

C_r = The probability of contaminant induced mortality for 1-year and older fish; and

C_f = The fractional reduction in fecundity due to contaminant exposure for 1-year and older fish;

This model is complex, but is based on good science published in peer-reviewed journals. A thorough description of this model is beyond the scope of this Appendix. We are providing a brief over-view of its important components. If the reader wishes to learn of the statistical methodologies used to fit field-collected data to these parameters (e.g., s_i, f_i, and m_i), please refer to Suter (1993) and Barnthouse et al. (1990).

Laboratory generated toxicity data is then used to determine the potential impact of the contaminant on the largemouth bass population, via calculation of s_o, C_m, and C_f. The authors assume that any female surviving to age 1 with chronic exposure to the contaminant, will not be susceptible to mortality from exposure as an adult. Therefore, the value C_r is removed from the model described in Equation 3. The chemical-specific data were modeled with a variety of approaches. Optimally, data from a life-stage-specific concentration-response experiment for a chronic exposure of largemouth bass were fitted to these parameters. Due to the difficulty in obtaining life cycle tests for the species of interest, other test data were selected to provide an adequate data set for modeling. The priority and methods used to incorporate other data are listed below:

1. Life-stage-specific chronic test for a different species – Taxonomic Extrapolations;

2. Non-life-stage-specific chronic test for largemouth bass – Life Stage Extrapolations;

3. Non-life-stage-specific chronic test for a different species – Life Stage and Taxonomic Extrapolations;

4. Acute test for largemouth bass – Acute to Chronic Extrapolations; and

5. Acute test for a different species – Acute to Chronic and Taxonomic Extrapolations.

The appropriate uncertainty factors were applied with each extrapolation. All extrapolation models were based on regression analyses and are presented in Table 3 of Barnthouse et al. (1990). The results are concentration-response functions for:

- Chronic mortality of eggs, larvae, and juveniles; and

- Reduction in fecundity of the surviving females.

Probabilistic approaches are then applied to these concentration-response functions to determine the likely decremental effect various exposure concentrations have on chronic mortality of the three age classes and the reduction in fecundity. This results in an estimate of the fraction of eggs, larvae, and juveniles expected to die from exposure (C_e, C_l, and C_j, respectively) and the reduction in fecundity (C_f). Now, values s_o and C_m can be calculated from the estimates of chronic mortality at each age class.

$$C_m = 1 - \left[(1 - C_e)(1 - C_l)(1 - C_j)\right] \quad (4)$$

$$S_o = e^{-(\alpha - \ln(1-C_m)) + R\sigma - 0.5\sigma^2 - \beta N_o} \quad (5)$$

Where,

α = The expected annual instantaneous rate of density-independent mortality;

σ = The standard deviation of α;

R = The unit random normal deviate; and

β = The coefficient of density dependence.

For each of these concentration-response extrapolations, multiple simulations were conducted. The geometric means and prediction intervals were then calculated from all runs of the model with that particular concentration-response extrapolation. With this approach each contaminant may have one or more concentration-response extrapolated models, each with its own geometric mean and prediction intervals. These values are reported in Appendix C of Suter and Tsao (1996). The values we present are a summary of Appendix C results, based on Table 2 of Suter and Tsao (1996).

In summary, the Population EC20 concentration represent a 20% reduction in recruitment of largemouth bass populations. These values reflect population dynamics affected by natural and anthropogenic sources, by integrating bench-scale toxicology studies with field studies in ecology. Tables G-5 to G-7 and G-14 report the Population EC20 benchmarks.

G - 3.0 ECOLOGICAL BENCHMARKS FOR EXPOSURES TO SEDIMENT

The available sediment quality criteria and benchmarks for the protection of aquatic life were reviewed and summarized in Tables G-8 to G-10 and G-15. Sources of the criteria and benchmarks with a description of the taxonomic breadth applicable to each are listed below:

- USEPA Freshwater Sediment Quality Criteria for the Protection of Benthic Organisms (SQC: results from eight separate toxicity tests representing the responses of at least at least eight families of aquatic biota);
- USEPA Guidelines for Deriving Site-Specific Sediment Quality Benchmarks for the Protection of Benthic Organisms (SQB: results from at least three separate toxicity tests representing the responses of at least three families of aquatic biota);
- Effects Range Concentrations from the National Oceanic and Atmospheric Administration Status and Trends Program (ERL);

- Canadian Sediment Quality Guidelines for the Protection of Freshwater Aquatic Life (ISQG);
- No-Effect Levels derived using the approach published by the government of the Netherlands (NEL: 19 aquatic species, covering prokaryotes, eukaryotes, invertebrates, and/or vertebrates); and
- U. S. EPA's Office of Research and Development, ΣPAH Mixture LC50 (four species of marine and estuarine amphipods).

Many of these benchmarks allow site-specific calculations that adjust for bioavailable fractions of the organic contaminants. The site-specific calculations require an estimation of Total Organic Carbon (TOC) in the sediments. These data are currently not available. Therefore, a value of 1% TOC is used for presentation purposes. The available benchmarks are described briefly below.

G - 3.1 EPA Sediment Quality Criteria for the Protection of Benthic Organisms

The USEPA has established sediment quality criteria for three PAHs (acenaphthene, fluoranthene, and phenanthrene) and phenol. These criteria are based on the Equilibrium Partitioning (EqP) methodology and are predictive of biological effects, protective of benthic organisms, and applicable to the range of natural sediments from lakes, streams, estuaries and near coastal marine waters (USEPA, 1993a-d). The EqP approach is founded on the theory that at equilibrium, non-ionic organic chemicals in sediment will partition between a binding phase and the sediment pore water. The primary binding phase for non-ionic organic chemicals in sediments is organic carbon. If a chemical is bound to the sediments, it is not bioavailable, and there is little potential for that chemical to cause biological effects (DiToro et al., 1991).

The criteria for individual compounds are computed using the equation:

$$SQC_{oc} = K_{oc} * FCV \quad (6)$$

where:

SQC_{oc} = Sediment Quality Criteria (μg/g organic carbon)

K_{oc} = Partition coefficient between sediment and pore water (L/g sediment)

FCV = Final Chronic Value from the EPA Water Quality Benchmarks (μg/L)

The organic carbon partition coefficient (K_{oc}) can be calculated from the octanol/water partition coefficient (K_{ow}):

$$\log K_{oc} = 0.00028 + 0.983 \log K_{ow} \quad (7)$$

By substitution, the equation (6) for calculating sediment quality criteria becomes:

$$SQC_{oc} = FCV \times 10^{(0.00028+0.983 \log K_{ow})} \quad (8)$$

This equation provides criteria on an organic carbon basis (µg compound/g organic carbon) which are converted to dry sediment basis (µg compound/kg sediment) by multiplying the criteria by the mean total organic carbon (TOC) content of the sediment samples.

$$SQC_{sediment} = FCV \times 10^{(0.00028+0.983 \log K_{ow})} \times TOC \quad (9)$$

Both the carbon-based (µg/g OC) and bulk sediment-based (µg/kg) SQC are summarized in Tables G-8 and G-9 of this appendix.

G - 3.2 USEPA Guidelines for Deriving Site-Specific Sediment Quality Benchmarks for the Protection of Benthic Organisms

The USEPA guidelines for deriving site-specific benchmarks for organic compounds uses the Equilibrium Partitioning (EqP) approach described above. These Sediment Quality Benchmarks (SQBs) are used for nonionic COPC that lack a SQC. These values are calculated by substituting the FCV with the GLWQI Tier II SCV in Equations 7 and 8. Therefore, the results are based on the responses of aquatic organisms from at least three families. The K_{ow} values that were used for these calculations are presented in Table G-2 to G-3 of this appendix. The U. S. EPA's OSWER also calculates SQBs based on Tier II SCV for sediment Ecotox Thresholds (U. S. EPA, 1996b). As with the SQC, both the carbon-based (µg/g oc) and bulk sediment-based guidelines are summarized in Tables G-8, G-9, and G-15 of this appendix.

G – 3.3 Canadian Sediment Quality Guidelines for the Protection of Freshwater Aquatic Life

The Canadian Environmental Quality Guidelines (EQG) for the protection of Freshwater Aquatic Life from contaminated sediments are currently Interim Sediment Quality Guidelines (ISQGs) (CCME, 1999). The available Canadian guidelines have only one concentration for each compound and no site-specific environmental variables can be used to compute values reflective of current site conditions. The guidelines are presented in Tables G-8 to G-10 and G-15 of this appendix.

G - 3.4 National Oceanic and Atmospheric Administration Effects Range Low (ERL)

Since 1984, the National Oceanic and Atmospheric Administration (NOAA) has administered the National Status and Trends (NS&T) program. One aspect of this program was to systematically collect and analyze sediments from estuaries throughout the United States. Using these data, a biological effects database for sediments (BEDS) was developed. These data were sorted in order of increasing concentrations that were associated with adverse biological effects for various compounds. An "Effects Range-Low" (ER-L) value was selected at the 10th percentile of the data to conservatively estimate the bulk sediment concentration at which there is a potential for adverse effects (Long and Morgan, 1990; Long et. al., 1995).

ERLs have recently been compiled and updated by NOAA and are available on the web (NOAA, 1999). The compilation has been termed "SQuiRTs" or Screening Quick Reference Tables. NOAA's Coastal Protection and Restoration Division use SQuiRTs for preliminary screening of potential impacts to coastal resources. The limitation of this criterion is discussed further below.

There are two important limitations for using the ER-L values for screening constituents at in a freshwater ecosystem. First, the NOAA database was developed with data collected from estuaries. The species which inhabit these brackish ecosystems might not be representative of freshwater ecosystems, they might be more, or less sensitive to sediment-associated substances. Secondly, the ER-L values do not account for bioavailability, or the toxicity of complex mixtures. Therefore, the ER-L values are very conservative estimates of concentrations of a particular substance that are associated with biological effects and must be used with caution for freshwater ecosystems. A similar database is not available for freshwater ecosystems, so these values are presented in Tables G-8 to G-10 of this appendix.

G - 3.5 No-Effect Levels (Netherlands Approach)

The approach for calculating sediment quality benchmarks published by Van Leeuwen et al. (1992) also applies equilibrium partitioning theory to convert water NELs to sediment NELs. The sediment HC5s printed in the tables of that document are not suitable for application to this study because they are based on 5% organic carbon content in sediments. Since the mean sediment organic carbon content of this facility is currently unknown, we are using the 2.5% estimate from soil surveys (Awalt, 1996 and Kelly, 1981). Therefore, to allow for TOC-adjustments, sediment NELs were calculated using Van Leeuwen's equation 7:

$$NEL_{sediment} = NEL_{water} * 10^{-0.21}*K_{ow}*f_{oc} \quad (10)$$

where:

f_{oc} = fraction of sediment that is organic carbon

K_{ow} values are supplied in Table G-2 and G-3 of this appendix

NEL_{water} values are the NELs supplied in Tables G-5 and G-6 of this appendix.

The sediment values calculated using equation (10) are presented in Tables G-8 and G-9 of this appendix.

G-3.6 U. S. EPA Office of Research and Development ΣPAH Mixture LC50

The ΣPAH Mixture LC50 benchmark is very useful because it accounts for the potential cumulative toxicity of 13 separate compounds that are typically found together within a contaminated site (Swartz, 1999). Experimentally it has been shown that PAH compounds illicit toxic effects based on an additive model. Therefore, the total toxicity of 13 PAH compounds found in a mixture can be estimated based on the summation of the toxicity for each PAH compound. The ΣPAH Mixture LC50 benchmark for sediment is derived from laboratory experimentation with flouranthene, acenaphthene, and phenanthrene. Four species of marine and estuarine amphipods were exposed to sediments spiked separately with these three PAHs. Based on PAH concentrations observed in the sediment pore water from these exposures, the following QSAR regression equation was produced:

$$\log 10 \cdot dLC50_{iw} = 5.92 - 1.33 \log K_{ow} \qquad (11)$$

Where,

$10\text{-}dLC50_{iw}$ = PAH concentration in the sediment pore water that caused a 50% mortality in amphipods.

This QSAR regression model based on concentration-response observations was used to estimate the $10\text{-}dLC50_{iw}$ values for the remaining 10 PAH compounds, based on their Kow values (Table G-2 and G-3). A Toxic Unit can then be estimated by dividing observed concentrations of PAH_{iw} from field collected samples by the $10\text{-}dLC50_{iw}$ value for each PAH. One TU is equal to the concentration of a single PAH that would cause a 50% mortality in amphipods. Swartz et al., (1995) used the observations from 33 field collected sediment samples from sites containing PAHs to determine the average TUs observed in the field for each of the 13 PAH compounds. For the current presentation we have incorporated the results from these field collected samples to calculate a ΣPAH Mixture LC50 for each PAH. However, if PAH compounds are prevalent on the facility, we will adjust the TU measurements to reflect our site conditions. For the 33 field collected samples, Swartz et al. (1995) determined the percent contribution to the total TUs (ΣTU) per sample for each of the 13 PAHs. These results are summarized in Table G-4 and Tables 7 and 1 in Swartz et al. (1995) and Swartz (1999), respectively.

In order to devise benchmark for each PAH compound to compare to bulk sediment concentrations from field collected samples, the EqP model (Equation 9) is used to derive the $10\text{-}dLC50_{sediment}$ value for each PAH compound. Since the 10-dLC50 value is based on the concentration of a single PAH to illicit 50% mortality, the ΣPAH Mixture LC50 benchmarks for each PAH is derived by multiplying the $10\text{-}dLC50_{sediment}$ value by its

individual average fractional contribution to ΣTUs. These values are presented in Table G-9 with the SVOCs.

Table G-4. Results of Swartz et al. (1995) for 33 field collected sediment samples illustrating the average percent contribution of each PAH to the ΣTUs per sample.

Polycyclic Aromatic Hydrocarbons	Mean Contribution to ΣTUs
Naphthalene	1.0%
Acenaphthylene	0.3%
Acenapthene	1.0%
Fluorene	2.0%
Phenanthrene	7.0%
Anthracene	2.7%
Fluoranthene	11.2%
Pyrene	17.1%
Chrysene	7.9%
Benzo(a)anthracene	5.2%
Benzo(b)fluoranthene	16.4%
Benzo(a)pyrene	10.8%
Benzo(k)fluoranthene	17.4%

G-4.0 SOIL BENCHMARKS

The available ERBCs for terrestrial receptors is limited compared to available surface water and sediment ERBCs. However, benchmarks for soil are summarized below and reported in Tables G-11 to G-13 and G-16.

G-4.1 Oak Ridge Toxicological Benchmarks

Soil ecological benchmarks were compiled and calculated by the Risk Assessment Program at the Oak Ridge National Laboratory (Efroymson et al., 1997). These benchmarks include:

- Toxicological Benchmarks for Earthworms;
- Toxicological Benchmarks for Microbial Processes; and
- Ecotoxicological Intervention Values (EIVs)

Earthworms are geophagus organisms, ingesting large volumes of soil in order to feed on decaying organic matter. This large degree of potential exposure to soil contaminants has made the earthworm one of the more popular test species for toxicity testing. Efroymson et al. (1997) compiled toxicity data only for earthworms exposed to natural or natural and artificial soil for the benchmarks presented herein. The earthworm benchmarks are based on acute and chronic toxicity tests for species from three families *(Megascolecidae, Eudrilidae,* and *Lumbricidae*). Generally the lowest LOEC was choosen as the final benchmarks, and uncertainty factors were applied when only acute endpoints were available.

Soil microorganisms play an important role in an ecosystem. Soil microbes supply a trophic linkage to both primary producers, by converting nutrients to a more bioavailable form, and secondary consumers. Toxic responses typically include growth, respiration, and any functional service they provide to the ecosystem (e.g., N mineralization, nitrification, P mineralization, etc...). Most of the data used to derive these benchmarks were based on responses from native microflora exposed in soil or soil/litter microcosms. Generally, the lowest of all reported values was used as the benchmark.

Ecotoxicological Intervention Values (EIVs) were developed by the Dutch National Institute of Public Health (RIVM). These values are intended to represent concentrations at which 50% of the species in an ecosystem will experience adverse effects. The Oak Ridge researchers have adjusted these values for organic matter and clay content specific to their needs.

G-4.2 Dutch Soil Cleanup (Interim) Act

Soil benchmarks are also available from the Dutch Soil Cleanup (Interim) Act (Beyer, 1990). These values pre-date the Dutch EIVs described above, and are intended to assess the need for remediation. Three different indicators are reported from this Act. The Level "B" benchmarks were chosen, because these values represent thresholds at which further investigation is required.

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Table G-2. Summary of values used to calculate NELs for VOCs in Water and Sediment.

Compound	CAS Number	Molecular Weight g/mole	[1]Log HC5 mole/L	log Kow	[2]Total Organic Carbon g/ g sediment	References
Acetone	67-64-1	58.08	-2.8	-0.24	0.01	All values: Van Leeuwen et al., 1992.
2-Butanone	78-93-3	72.11	-3.24	0.29	0.01	All values: Van Leeuwen et al., 1992.
Carbon disulfide	75-15-0	76.13	-5.06	2.16	0.01	HC5: Van Leeuwen et al., 1992 Kow: U. S. EPA, 1992c
Benzene	71-43-2	78.11	-5.06	2.19	0.01	All values: Van Leeuwen et al., 1992.
Methylene chloride	75-09-2	84.93	-4.16	1.25	0.01	All values: Van Leeuwen et al., 1992.
Methyl tert-butyl ether	1634-04-4	88.15	-3.78	0.94	0.01	All values: Van Leeuwen et al., 1992.
Toluene	108-88-3	92.13	-5.68	2.79	0.01	All values: Van Leeuwen et al., 1992.
1,1-Dichloroethene	75-35-4	96.94	-4.36	1.48	0.01	HC5: Van Leeuwen et al., 1992 Kow: U. S. EPA, 1992c
1,2-Dichloroethene (total)	156-60-5	96.94	-4.36	1.48	0.01	HC5: Van Leeuwen et al., 1992 Kow: U. S. EPA, 1992c
1,1-Dichloroethane	75-34-3	98.95	-4.65	1.79	0.01	All values: Van Leeuwen et al., 1992.
1,2-Dichloroethane	107-06-2	98.95	-4.36	1.48	0.01	All values: Van Leeuwen et al., 1992.
2-Hexanone	591-78-6	100.16	-4.26	1.38	0.01	HC5: Van Leeuwen et al., 1992 Kow: U. S. EPA, 1992c
4-Methyl-2-pentanone	108-10-1	100.16	-4.16	1.31	0.01	All values: Van Leeuwen et al., 1992.
Xylenes	95-47-6	106.16	-6.10	3.20	0.01	All values: Van Leeuwen et al., 1992.
Ethylbenzene	100-41-4	106.17	-6.00	3.13	0.01	MW, Kow: McKay et al., 1995; HC5: Van Leeuwen et al., 1992.
cis-1,3-dichloropropene	10061-01-5	110.97	-4.26	1.41	0.01	Kow: McKay et al., 1995; HC5: Van Leeuwen et al., 1992.
Chlorobenzene	108-90-7	112.57	-5.79	2.9	0.01	All values: Van Leeuwen et al., 1992.
1,2-Dichloropropane	78-87-5	112.98	-4.86	1.99	0.01	All values: Van Leeuwen et al., 1992.
Chloroform	67-66-3	119.39	-4.86	1.97	0.01	All values: Van Leeuwen et al., 1992.
Trichloroethene	79-01-6	131.4	-5.26	2.42	0.01	All values: Van Leeuwen et al., 1992.
1,1,2-Trichloroethane	79-00-5	133.39	-4.75	1.89	0.01	All values: Van Leeuwen et al., 1992.
1,1,1-Trichloroethane	71-55-6	133.41	-5.37	2.49	0.01	All values: Van Leeuwen et al., 1992.
1,2 Dichlorobenzene	95-50-1	147.01	-6.32	3.43	0.01	All values: Van Leeuwen et al., 1992.
1,3 Dichlorobenzene	541-73-1	147.01	-6.43	3.53	0.01	All values: Van Leeuwen et al., 1992.
1,4 Dichlorobenzene	106-46-7	147.01	-6.32	3.44	0.01	All values: Van Leeuwen et al., 1992.
Carbon tetrachloride	56-23-5	153.82	-5.68	2.83	0.01	All values: Van Leeuwen et al., 1992.
Tetrachloroethene	127-18-4	165.83	-6.32	3.4	0.01	All values: Van Leeuwen et al., 1992.
1,1,2,2-Tetrachloroethane	79-34-5	167.84	-5.26	2.39	0.01	All values: Van Leeuwen et al., 1992.
1,2,4-Trichlorobenzene	120-82-1	181.43	-7.08	4.05	0.01	All values: Van Leeuwen et al., 1992.

[1]HC5 values based on Tables 1 and 6 in Van Leeuwen et al., 1992. These values represent a concentration that is estimated to protect 95% of species from chronic toxicity.

[2]Assumed 1.0% Total Organic Carbon for all sediment samples.

Table G-3. Summary of values used to calculate NELs for SVOCs in Water and Sediment.

Compound	CAS Number	Molecular Weight g/mole	[1]Log HC5 mole/L	log Kow	[2]Total Organic Carbon g/ g sediment	References
Benzyl alcohol	100-51-6	108.14	-3.97	1.1	0.01	Kow: U. S. EPA 1992c
2-Methylphenol	95-48-7	108.14	-4.75	1.95	0.01	Kow: U. S. EPA 1992c HC5: Van Leeuwen et al., 1992
Acetophenone	98-86-2	120.15	-4.46	1.58	0.01	All values: Van Leeuwen et al., 1992.
Naphthalene	91-20-3	128.16	-6.21	3.366958	0.01	HC5: Van Leeuwen et al., 1992. Kow: Swartz et al., 1995
4-Nitrophenol	100-02-7	139.11	-4.75	1.91	0.01	Kow: U. S. EPA 1992c HC5: Van Leeuwen et al., 1992
1- and 2-Methylnaphthalene	91-57-6	142.2	-6.86	3.86	0.01	MW, Kow: McKay et al., 1992b; HC5: Van Leeuwen et al., 1992.
Acenaphthylene	208-96-8	152.2	-6.97	4.07	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992; MW: EPA, 1992
Acenapthene	83-32-9	154.21	-6.86	3.845086	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992.
Fluorene	86-73-7	166.22	-7.19	4.180793	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992.
Dibenzofuran	132-64-9	168.19	-7.08	4.12	0.01	Kow: U. S. EPA 1992c HC5: Van Leeuwen et al., 1992
Phenanthrene	85-01-8	178	-7.41	4.363906	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992
Anthracene	120-12-7	178.23	-7.52	4.45	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992; MW: EPA, 1992
N-Nitrosodiphenylamine	86-30-6	198.23	-5.68	2.79	0.01	Kow: U. S. EPA 1992c HC5: Van Leeuwen et al., 1992
Fluoranthene	206-44-0	202.26	-8.19	5.086185	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992.
Pyrene	129-00-0	202.26	-8.41	5.320163	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992.
Diethylphthalate	84-66-2	222.24	-5.37	2.47	0.01	MW, Kow: McKay et al., 1995 HC5: Van Leeuwen et al., 1992
Chrysene	218-01-9	228.29	-8.75	5.605005	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992.
Benzo(a)anthracene	56-55-3	228.29	-8.75	5.61	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992; MW: EPA, 1992
Hexachloroethane	67-72-1	236.72	-7.08	4.14	0.01	All values: Van Leeuwen et al., 1992.
4-Bromophenyl phenyl ether	101-55-3	249	-8.3	5.24	0.01	All values: Van Leeuwen et al., 1992.
Benzo(b)fluoranthene	205-99-2	252.32	-9.519334	6.571434	0.01	Kow: Swartz et al., 1995; aHC5: Van Leeuwen et al., 1992.
Benzo(a)pyrene	50-32-8	252.32	-9.21	6.04	0.01	Kow: Swartz et al., 1995; HC5: Van Leeuwen et al., 1992; MW: EPA, 1992
Benzo(k)fluoranthene	207-08-9	252.32	-9.780128	6.84	0.01	Kow: Swartz et al., 1995; aHC5: Van Leeuwen et al., 1992.,
Benzo(ghi)perylene	191-24-2	276.34	-9.4489	6.50	0.01	MW, Kow: McKay et al., 1992a; [a]HC5: Van Leeuwen et al., 1992.
Indeno(1,2,3-cd)pyrene	193-39-5	276.34	-10.59266	7.66	0.01	Kow, MW: EPA, 1992; [a]HC5: Van Leeuwen et al., 1992.
Di-n-butylphthalate	84-74-2	278.35	-8.3	5.20	0.01	Kow: U. S. EPA 1992c HC5: Van Leeuwen et al., 1992
Dibenzo(a,h)anthracene	53-70-3	278.35	-9.6954	6.75	0.01	MW, Kow: McKay et al., 1992a; [a]HC5: Van Leeuwen et al., 1992.
Benzyl butyl phthalate	85-68-7	312.4	-7.97	4.91	0.01	MW, Kow: McKay et al., 1995 HC5: Van Leeuwen et al., 1992
bis(2-Ethylhexyl)phthalate	117-81-7	390.54	-8.19	5.11	0.01	MW, Kow: McKay et al., 1995 HC5: Van Leeuwen et al., 1992

[1]HC5 values based on Tables 1 and 6 in Van Leeuwen et al., 1992. These values represent a concentration that is estimated to protect 95% of species from chronic toxicity.

[2]Assumed 2.5% Total Organic Carbon for all sediment samples.

[a]Dissolved Log HC5 value estimated by a regression equation of Van Leeuwen Table 6 values (Fig. A.1) y = -0.9864x - 3.0399, R2 = 0.996

Table G-5. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Volatile Organic Compounds in water.

Volatiles (SW-846/8260) USEPA CLP TCL - VOCs	CAS Number	[1]Method Detection Limit (ug/L)	[1]Reporting Limit (ug/L)	[2,a]Oak Ridge FCV (ug/L)	[2,b]Oak Ridge LCV (ug/L)	[2,b]Oak Ridge Teir II SCV (ug/L)	[3]CCME EQGs (ug/L)	[4]Dutch NELs (ug/L)	[2,c]Oak Ridge Population EC20 (ug/L)
Acetone	67-64-1	0.49	10	-	507,604	1,500	-	92051	23,714
Benzene	71-43-2	0.096	1	-	525,000	130	370	680	229
Bromodichloromethane	75-27-4	0.21	1	-	-	-	-	-	-
Bromoform	75-25-2	0.2	1	-	-	-	-	-	-
Bromomethane	74-83-9	0.22	2	-	-	-	-	-	-
2-Butanone	78-93-3	0.39	10	-	282,170	14,000	-	41495	17,783
Carbon disulfide	75-15-0	0.18	1	-	244	0.92	-	663	1,000
Carbon tetrachloride	56-23-5	0.12	1	-	1,970	9.8	13.3	322	224
Chlorobenzene	108-90-7	0.15	1	-	1203	64	1.3	183	165
Chloroethane	75-00-3	0.25	2	-	-	-	-	-	-
Chloroform	67-66-3	0.13	1	-	1,240	28	1.8	1648	562
Chloromethane	74-87-3	0.17	2	-	-	-	-	-	-
Cyclohexane	110-82-7	0.16	1	-	-	-	-	-	-
Dibromochloromethane	124-48-1	0.1	1	-	-	-	-	-	-
1,2-Dibromo-3-chloropropane	96-12-8	0.26	2	-	-	-	-	-	-
1,2-Dibromoethane	106-93-4	0.16	1	-	-	-	-	-	-
1,2-Dichlorobenzene	95-50-1	0.13	1	-	-	14	-	70.4	-
1,3-Dichlorobenzene	541-73-1	0.18	1	-	-	71	-	54.6	-
1,4-Dichlorobenzene	106-46-7	0.13	1	-	-	15	-	70.4	-
Dichlorodifluoromethane	75-71-8	0.23	2						
1,1-Dichloroethane	75-34-3	0.12	1	-	14,680	47	-	2215	1,585
1,2-Dichloroethane	107-06-2	0.11	1	-	15,200	910	100	4319	1,259
1,1-Dichloroethene	75-35-4	0.3	1	-	2,800	25	-	4232	447
1,2-Dichloroethene (total)	156-60-5	0.1	1	-	9,538	590	-	4232	-
1,2-Dichloropropane	78-87-5	0.13	1	-	-	-	-	1560	-
cis-1,3-Dichloropropene	0061-01-5	0.15	1	-	244	NA	-	-	40
trans-1,3-Dichloropropene	0061-02-6	0.12	1	-	-	-	-	-	40
Ethylbenzene	100-41-4	0.22	1	-	440	7.3	90	106	398
2-Hexanone	591-78-6	0.18	10	-	32,783	99	-	5504	1,259
Isopropylbenzene	98-82-8	0.15	1	-	-	-	-	-	-
Methyl acetate	79-20-9	0.81	10	-	-	-	-	-	-

Table G-5. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Volatile Organic Compounds in water.

Volatiles (SW-846/8260) USEPA CLP TCL - VOCs	CAS Number	[1]Method Detection Limit (ug/L)	[1]Reporting Limit (ug/L)	[2,a]Oak Ridge FCV (ug/L)	[2,b]Oak Ridge LCV (ug/L)	[2,b]Oak Ridge Teir II SCV (ug/L)	[3]CCME EQGs (ug/L)	[4]Dutch NELs (ug/L)	[2,c]Oak Ridge Population EC20 (ug/L)
Methylene chloride	75-09-2	0.19	1	-	42,667	2,200	98.1	5876	1,259
Methylcyclohexane	108-87-2	0.11	1	-	-	-	-	-	-
4-Methyl-2-pentanone	108-10-1	0.33	10	-	77,400	170	-	6929	1,585
Methyl tert-butyl ether	1634-04-4	0.11	5	-	-	-	-	14629	-
Styrene	100-42-5	0.19	1	-	-	-	72	-	-
1,1,2,2-Tetrachloroethane	79-34-5	0.12	1	-	2,400	610	-	922	1,585
Tetrachloroethene	127-18-4	0.21	1	-	750	98	-	79.4	50
Toluene	108-88-3	0.13	1	-	1,269	9.8	2	192	200
1,2,4-Trichlorobenzene	120-82-1	0.15	1		-	110	-	15	-
1,1,1-Trichloroethane	71-55-6	0.16	1	-	3,493	11	-	569	251
1,1,2-Trichloroethane	79-00-5	0.21	1	-	9,400	1,200	-	2372	15,849
Trichloroethene	79-01-6	0.18	2	-	7,257	47	-	722	232
Trichlorofluoromethane	75-69-4	0.21	2	-	-	-	-	-	-
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.18	1	-	-	-	-	-	-
Vinyl chloride	75-01-4	0.097	2	-	-	-	-	-	-
Xylenes	95-47-6	0.58	1	-	62,308	13		84.3	-

NA - Not Applicable: value has been excluded due to assumptions made in its derivation (see Appendix G narrative).

- benchmark is not available for this compound.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results (Table: WATER; PURGE and TRAP; Volatile Organics, GC/MS).

[2]Suter and Tsao (1996).

[a]Benchmark based on results from at least three separate toxicity tests representing the responses of at least three families of aquatic biota

[b]Benchmark based on results from at least one toxicity study representing the responses of at least one species

[c]Benchmark based on results from largemouth bass, only.

[3]CCME (1999)

[4]Van Leeuwen et al. (1992). Benchmark based on results from 19 aquatic species, covering prokaryotes, eukaryotes, invertebrates, and/or vertebrates.

G-6. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Semi-Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons in water.

Semi-Volatiles & PAHs (SW-846/8270C & 8310) USEPA CLP TCL - SVOCs	CAS Number	[1]Method Detection Limit (ug/L)	[1]Reporting Limit (ug/L)	[2,a]Oak Ridge FCV (ug/L)	[2,b]Oak Ridge LCV (ug/L)	[2,b]Oak Ridge Teir II SCV (ug/L)	[3]CCME EQGs (ug/L)	[4]Dutch NELs (ug/L)	[2,c]Oak Ridge Population EC20 (ug/L)
Acenapthene[d]	83-32-9	0.12	1	23	74	-	5.8	21.3	-
Acenaphthylene[d]	208-96-8	0.039	1	-	-	-	-	16.3	-
Acetophenone[e]	98-86-2	3.7	10					4166	
Anthracene[d]	120-12-7	0.005	0.2	-	NA	0.73	0.012	5.38	-
Atrazine[e]	1912-24-9	2.3	10	-	-	-	1.8	-	-
Benzaldehyde[e]	100-52-7	1.6	10	-	-	-	-	-	-
Benzo(a)anthracene[d]	56-55-3	0.006	0.2	-	0.65	0.027	0.018	0.406	-
Benzo(a)pyrene[d]	50-32-8	0.009	0.2	-	0.3	0.014	0.015	0.156	-
Benzo(b)fluoranthene[d]	205-99-2	0.016	0.2	-	-	-	-	0.076	-
Benzo(k)fluoranthene[d]	207-08-9	0.0064	0.2	-	-	-	-	0.042	-
Benzo(g,h,i)perylene[d]	191-24-2	0.014	0.2	-	-	-	-	0.0983	-
Benzyl butyl phthalate[e]	85-68-7	1.9	10	-	-	19	-	3.35	-
1,1'Biphenyl[e]	92-52-4	2.1	10	-	-	14	-	-	-
bis(2-Chloroethoxy)methane[e]	111-91-1	2.6	10	-	-	-	-	-	-
bis(2-Chloroethyl)ether[e]	111-44-4	2.1	10	-	-	-	-	-	-
bis(2-Ethylhexyl)phthalate[e]	117-81-7	2.1	10	-	912	3	-	2.52	50
4-Bromophenyl phenyl ether[e]	101-55-3	1	10	-	-	1.5	-	1.25	-
Caprolactam[e]	105-60-2	2.6	10	-	-	-	-	-	-
Carbazole[d]	86-74-8	0.167	1	-	-	-	-	-	-
4-Chloroaniline[e]	106-47-8	2.8	10	-	-	-	-	-	-
4-Chloro-3-methylphenol[e]	59-50-7	1.2	10	-	-	-	-	-	-
2-Chloronaphthalene[e]	91-58-7	2.5	10	-	-	-	-	-	-
2-Chlorophenol[e]	95-57-8	1.6	10	-	-	-	-	-	-
4-Chlorophenyl phenyl ether[e]	7005-72-3	1.3	10	-	-	-	-	-	-
Chrysene[d]	218-01-9	0.009	0.2	-	-	-	-	0.406	-
Dibenz(a,h)anthracene[d]	53-70-3	0.024	0.2	-	-	-	-	0.0561	-
Dibenzofuran[d]	132-64-9	NA	1	-	1,003	3.7	-	14.0	-
3,3'-Dichlorobenzidine[e]	91-94-1	1.1	50	-	-	-	-	-	-

G-6. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Semi-Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons in water.

Semi-Volatiles & PAHs (SW-846/8270C & 8310) USEPA CLP TCL - SVOCs	CAS Number	[1]Method Detection Limit (ug/L)	[1]Reporting Limit (ug/L)	[2,a]Oak Ridge FCV (ug/L)	[2,b]Oak Ridge LCV (ug/L)	[2,b]Oak Ridge Teir II SCV (ug/L)	[3]CCME EQGs (ug/L)	[4]Dutch NELs (ug/L)	[2,c]Oak Ridge Population EC20 (ug/L)
2,4-Dichlorophenol[e]	120-83-2	1	10	-	-	-	-	-	-
Diethylphthalate[e]	84-66-2	3.2	10	-	85,600	210	-	948	1,000
2,4-Dimethylphenol[e]	105-67-9	1.1	10	-	-	-	-	-	-
Dimethyl phthalate[e]	99-65-0	3.7	10	-	-	-	-	-	-
Di-n-butylphthalate[e]	84-74-2	1.1	10	-	697	35	19	1.39	251
Di-n-octylphthalate[e]	117-84-0	2	10	-	708	-	-	-	1,995
4,6-Dinitro-2-Methylphenol[e]	534-52-1	7.5	50	-	-	-	-	-	-
2,4-Dinitrophenol[e]	51-28-5	13	50	-	-	-	-	-	-
2,4-Dinitrotoluene[e]	121-14-2	0.8	10	-	-	-	-	-	-
2,6-Dinitrotoluene[e]	606-20-2	2.8	10	-	-	-	-	-	-
Fluoranthene[d]	206-44-0	0.015	0.2	6.16	15	-	0.04	1.31	32
Fluorene[d]	86-73-7	0.005	0.2	-	-	3.9	3	10.7	-
Hexachlorobenzene[e]	118-74-1	1.8	10	-	-	-	-	-	-
Hexachlorobutadiene[e]	87-68-3	1.2	10	-	-	-	1.3	-	-
Hexachlorocyclopentadiene[e]	77-47-4	3.4	50	-	-	-	-	-	-
Hexachloroethane[e]	67-72-1	2.3	10	-	-	12	-	19.7	-
Indeno(1,2,3-cd)pyrene[d]	193-39-5	0.013	0.2	-	-	-	-	0.00706	-
Isophorone[e]	78-59-1	2.7	10	-	-	-	-	-	-
2-Methylnaphthalene[d]	91-57-6	0.064	1	-	-	-	-	19.6	-
Methylphenol (m-Cresol)	108-39-4	0.84	10	-	-	-	-	-	-
2-Methylphenol[e] (o-Cresol)	95-48-7	1.1	10	-	489	13	-	1923	74
4-Methylphenol[e] (p-Cresol)	106-44-5	1.7	10	-	-	-	-	-	1,000
Naphthalene[d]	91-20-3	0.066	1	-	620	12	1.1	79.0	-
2-Nitroaniline[e]	88-74-4	1.4	50	-	-	-	-	-	-
3-Nitroaniline[e]	99-09-2	2	50	-	-	-	-	-	-
4-Nitroaniline[e]	100-01-6	1.2	50	-	-	-	-	-	-
Nitrobenzene[e]	98-95-3	2.6	10	-	-	-	-	-	-
2-Nitrophenol[e]	88-75-5	0.99	10	-	-	-	-	-	-

G-6. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Semi-Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons in water.

Semi-Volatiles & PAHs (SW-846/8270C & 8310) USEPA CLP TCL - SVOCs	CAS Number	[1]Method Detection Limit (ug/L)	[1]Reporting Limit (ug/L)	[2,a]Oak Ridge FCV (ug/L)	[2,b]Oak Ridge LCV (ug/L)	[2,b]Oak Ridge Teir II SCV (ug/L)	[3]CCME EQGs (ug/L)	[4]Dutch NELs (ug/L)	[2,c]Oak Ridge Population EC20 (ug/L)
4-Nitrophenol[e]	100-02-7	4.8	50	-	481	300		2473.8	60
N-Nitro-di-n-propylamine[e]	621-64-7	1	10	-	-	-	-	-	-
N-Nitrosodiphenylamine[e]	86-30-6	0.91	10	-	332	210	-	414.2	40
2,2'-Oxybis(1-chloropropane)[e]	108-60-1	1.3	10	-	-	-	-	-	-
Pentachlorophenol[e]	87-86-5	0.58	10	-	-	-	0.5	-	-
Phenanthrene[d]	85-01-8	0.005	0.2	6.3	200	-	0.4	6.93	-
Phenol[e]	108-95-2	1.3	10	110	<200	-	4	-	4,467
Pyrene[d]	129-00-0	0.017	0.2	-	-	-	0.025	0.79	-
2,4,5-Trichlorphenol[e]	95-95-4	1.1	10	-	-	-	-	-	-
2,4,6-Trichlorphenol[e]	88-06-2	1.3	10	-	-	-	-	-	-

NA = Not Applicable: value has been excluded due to assumptions made in its derivation (see Appendix G narrative).

- benchmarks are not available for this compound

[1]Method Detection Limit and Reporting Limit based on Severn Trent results.

[2]Suter and Tsao (1996).

[a]Benchmarks based on results from at least three separate toxicity tests representing the responses of at least three families of aquatic biota

[b]Benchmarks based on results from at least one toxicity study representing the responses of at least one one species

[c]Benchmarks based on results from largemouth bass, only.

[3]CCME (1999)

[4]Van Leeuwen et al. (1992). Benchmarks based on results from 19 aquatic species, covering prokaryotes, eukaryotes, invertebrates, and/or vertebrates.

[d]MDL's and RL's based on results achieved by method 8310 (Table WATER; LIQ/LIQ, SEP FUNNEL (PAH, P/P, TPH, Dioxin); Hydrocarbons, Polynuclear Aromatic);

[e]MDL's and RL's based on results achieved by method 8270C (Table: WATER; LIQ/LIQ, CONT (A/B/N); Base/Neutrals and Acids)

Table G-7. Method Detection Limits and Reporting Limits compared to Ecological Benchmarks for Inorganics in water (assuming 100 mg/l calcium carbonate).

Inorganics USEPA CLP TAL	CAS Number	Method	[1]Method Detection Limit (ug/L)	[1]Reporting Limits (ug/L)	[2]U. S. EPA NAWQC CCC (ug/L)	[3,a]Oak Ridge LCV (ug/L)	[3,a]Oak Ridge Teir II SCV (ug/L)	[4]CCME EQGs (ug/L)	[3,b]Oak Ridge Population EC20 (ug/L)
Aluminum	7429-90-5	6010B IC3	20.3	200	-	460	-	5-100	-
Antimony	7440-36-0	6010B IC3	6.6	20	-	610	30	-	79
Arsenic	7440-38-2	6010B IC3	3.7	10	150	914.1	-	5	1,995
Barium	7440-39-3	6010B IC3	1	10	-	-	4	-	-
Beryllium	7440-41-7	6010B IC3	0.6	4	-	5.3	0.66	-	21
Cadmium	7440-43-9	6010B IC3	0.32	2	2.24	0.15	-	0.017	4.3
Calcium	7440-70-2	6010B IC3	26.5	100	-	116,000	-	-	-
Chromium	7440-47-3	6010B IC3	3.2	10	74.11	44	-	8.9	126
Cobalt	7440-48-4	6010B IC3	2	5	-	5.1	23	-	3.98
Copper	7440-50-8	6010B IC3	1.2	10	8.96	0.23		2-4	8.6
Cyanide	57-12-5	9012A (NC)	3.3	10	5.20	7.8	-	5.00	11
Iron	7439-89-6	6010B IC3	19.8	50	-	158	-	300	-
Lead	7439-92-1	6010B IC3	2.4	5	2.52	12.26	-	-	71
Magnesium	7439-95-4	6010B IC3	17.9	100	-	82,000	-	-	-
Manganese	7439-96-5	6010B IC3	0.92	5	-	<1,100	120	-	112
Mercury	7439-97-6	7470A (NC)	0.13	0.2	0.77	0.23	1.3	0.1	0.32
Nickel	7440-02-0	6010B IC3	1.6	10	52.01	5	-	25-150	215
Potassium	7440-09-7	6010B IC3	181	500	-	53,000	-	-	-
Selenium	7782-49-2	6010B IC3	2.9	5	5	88.32	-	1	-
Silver	7440-22-4	6010B IC3	2.5	5	-	0.12	0.36	0.1	0.32
Sodium	7440-23-5	6010B IC3	263	1000	-	680,000	-	-	-
Thallium	7440-28-0	6010B IC3	4.8	10	-	57	12	0.8	67
Vanadium	7440-62-6	6010B IC3	0.92	5	-	80	20	-	32
Zinc	7440-66-6	6010B IC3	9.7	10	118.14	30	-	30	80

- Benchmarks are not available for this element.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results (Tables: Metals, Filtered (Diss) - Total Recoverable (6010B IC3, 7470A) and Cyanide, Total (9012A, Automated)).

[2]U. S. EPA (1999b). Criteria based on results from eight separate toxicity tests representing the responses of at least at least eight families of aquatic biota

[3]Suter and Tsao (1996)

[a]Benchmark based on results from at least one toxicity study representing the responses of at least one species

[b]Benchmark based on results from largemouth bass, only.

[4]CCME (1999)

Table G-8. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Volatile Organic Compounds in sediment (assuming 1% TOC).

Volatiles (SW-846/8260B) USEPA CLP TCL - VOCs	CAS Number	[1]Method Detection Limit (ug/kg, ww)	[1]Reporting Limit (ug/kg, ww)	[2]U. S. EPA SQCs (ug/g, OC)	[2]U. S. EPA SQCs (ug/kg, dw)	[3]Oak Ridge SQBs (ug/g, OC)	[3]Oak Ridge SQBs (ug/kg, dw)	[4]CCME ISQGs (ug/kg, dw)	[5]NOAA ERLs (ug/kg, dw)	[6]Dutch NELs (ug/kg, dw)
Acetone	67-64-1	1.8	20	-	-	1	9	-	-	327
Benzene	71-43-2	0.63	5	-	-	18	185	-	-	650
Bromodichloromethane	75-27-4	0.65	5	-	-	-	-	-	-	-
Bromoform	75-25-2	0.5	5	-	-	-	-	-	-	-
Bromomethane	74-83-9	1.2	10	-	-	-	-	-	-	-
2-Butanone	78-93-3	4.8	20	-	-	27.0	270	-	-	499
Carbon disulfide	75-15-0	1.1	5	-	-	0.12	1.2	-	-	591
Carbon tetrachloride	56-23-5	0.62	5	-	-	5.93	59.3	-	-	1340
Chlorobenzene	108-90-7	0.72	5	-	-	45.4	454	-	-	894
Chloroethane	75-00-3	0.92	10	-	-	-	-	-	-	-
Chloroform	67-66-3	0.71	5	-	-	2.42	24.2	-	-	948
Chloromethane	74-87-3	0.73	10	-	-	-	-	-	-	-
Cyclohexane	110-82-7	1.1	10	-	-	-	-	-	-	-
Dibromochloromethane	124-48-1	0.57	5	-	-	-	-	-	-	-
1,2-Dibromo-3-chloropropane	96-12-8	3.1	10	-	-	-	-	-	-	-
1,2-Dibromoethane	106-93-4	0.63	5	-	-	-	-	-	-	-
1,2-Dichlorobenzene	95-50-1	0.68	5	-	-	33.0	330	-	-	1168
1,3-Dichlorobenzene	541-73-1	0.8	5	-	-	210	2097	-	-	1141
1,4-Dichlorobenzene	106-46-7	0.64	5	-	-	36.1	361	-	-	1195
Dichlorodifluoromethane	75-71-8	0.88	10	-	-	-	-	-	-	-
1,1-Dichloroethane	75-34-3	0.63	5	-	-	2.70	27.0	-	-	842
1,2-Dichloroethane	107-06-2	0.57	5	-	-	26.0	260	-	-	804
1,1-Dichloroethene	75-35-4	0.67	5	-	-	0.713	7.13	-	-	788
1,2-Dichloroethene (total)	156-60-5	0.61	5	-	-	16.826	168.26	-	-	788
1,2-Dichloropropane	78-87-5	0.65	5	-	-	-	-	-	-	940
cis-1,3-Dichloropropene	0061-01-5	0.61	5	-	-	NA	NA	-	-	967
trans-1,3-Dichloropropene	0061-02-6	0.59	5	-	-	-	-	-	-	-
Ethylbenzene	100-41-4	0.84	5	-	-	8.72	87.2	-	-	883
2-Hexanone	591-78-6	1.2	20	-	-	2.3	23	-	-	814
Isopropylbenzene	98-82-8	0.67		-	-	-	-	-	-	-
Methyl acetate	79-20-9	2.5	10	-	-	-	-	-	-	-
Methylene chloride	75-09-2	1.4	5	-	-	37.3	373	-	-	644
Methylcyclohexane	108-87-2	0.98	10	-	-	-	-	-	-	-
4-Methyl-2-pentanone	108-10-1	3.3	20	-	-	3.3	33	-	-	872

Table G-8. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Volatile Organic Compounds in sediment (assuming 1% TOC).

Volatiles (SW-846/8260B) USEPA CLP TCL - VOCs	CAS Number	[1]Method Detection Limit (ug/kg, ww)	[1]Reporting Limit (ug/kg, ww)	[2]U. S. EPA SQCs (ug/g, OC)	[2]U. S. EPA SQCs (ug/kg, dw)	[3]Oak Ridge SQBs (ug/g, OC)	[3]Oak Ridge SQBs (ug/kg, dw)	[4]CCME ISQGs (ug/kg, dw)	[5]NOAA ERLs (ug/kg, dw)	[6]Dutch NELs (ug/kg, dw)
Methyl tert-butyl ether	1634-04-4	0.44	20	-	-	-	-	-	-	786
Styrene	100-42-5	0.65	5	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	79-34-5	0.7	5	-	-	136	1365	-	-	1396
Tetrachloroethene	127-18-4	0.74	5	-	-	215.6	2156	-	-	1229
Toluene	108-88-3	0.75	5	-	-	5	54	-	-	732
1,2,4-Trichlorobenzene	120-82-1	0.87	5	-	-	1054	10540	-	-	1044
1,1,1-Trichloroethane	71-55-6	0.71	5	-	-	3.09	30.9	-	-	1084
1,1,2-Trichloroethane	79-00-5	0.54	5	-	-	86.6	866	-	-	1135
Trichloroethene	79-01-6	0.7	5	-	-	11.3	113	-	-	1171
Trichlorofluoromethane	75-69-4	1.8	10	-	-	-	-	-	-	-
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1.3	5	-	-	-	-	-	-	-
Vinyl chloride	75-01-4	0.66	10	-	-	-	-	-	-	-
Xylenes	95-47-6	2	10	-	-	18.2	182	-	-	824

NA = Not Applicable: value has been excluded due to assumptions made in its derivation.

- Benchmarks are not available for this compound.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results (Table: SOLID; PURGE and TRAP; Volatile Organics).

[2]U. S. EPA (1993b-d). Criteria based on results from eight separate toxicity tests representing the responses of at least at least eight families of aquatic biota

[3]Jones, Suter, and Hull (1997). Benchmarks based on results from at least one toxicity tests representing the responses of at least one species of aquatic biota.

[4]CCME (1999)

[5]NOAA (1999)

[6]Van Leeuwen et al. (1992). Benchmarks based on 19 aquatic species, covering prokaryotes, eukaryotes, invertebrates, and/or vertebrates

Table G-9. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Semi-Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons in sediment (assuming 1% TOC).

Semi-Volatiles & PAHs (SW-846/8270C & 8310) USEPA CLP TCL - SVOCs	CAS Number	[1]Method Detection Limit (ug/kg, ww)	[1]Reporting Limit (ug/kg, ww)	[2]U. S. EPA SQCs (ug/g, OC)	[2]U. S. EPA SQCs (ug/kg, dw)	[3]Oak Ridge SQBs (ug/g, OC)	[3]Oak Ridge SQBs (ug/kg, dw)	[4]CCME ISQGs (ug/kg, dw)	[5]NOAA ERLs (ug/kg, dw)	[6]Dutch NELs (ug/kg, dw)	[7]SPAH Mixture LC50 (ug/kg, dw)
Acenapthene[a]	83-32-9	1.9	33	130	1300	-	-	6.71	16	919	594
Acenaphthylene[a]	208-96-8	2.08	33	-	-	-	-	5.87	44	1178	147
Acetophenone[b]	98-86-2	28	330	-	-	-	-	-	-	977	-
Anthracene[a]	120-12-7	0.34	6.7	-	-	17.1	171	46.9	85.3	925	1148
Atrazine[b]	1912-24-9	24	330	-	-	-	-	-	-	-	-
Benzaldehyde[b]	100-52-7	98	330	-	-	-	-	-	-	-	-
Benzo(a)anthracene[a]	56-55-3	0.311	6.7	-	-	8.74	87.4	31.7	261	1008	1122
Benzo(a)pyrene[a]	50-32-8	0.844	6.7	-	-	12.2	122	31.9	430	1058	1815
Benzo(b)fluoranthene[a]	205-99-2	0.334	6.7	-	-	-	-	-	-	1754	1806
Benzo(k)fluoranthene[a]	207-08-9	0.391	6.7	-	-	-	-	-	-	1769	1551
Benzo(g,h,i)perylene[a]	191-24-2	0.254	6.7	-	-	-	-	-	-	1917	-
Benzyl butyl phthalate[b]	85-68-7	44	330	-	-	1275	12752	-	-	1678	-
1,1'Biphenyl[b]	92-52-4	17	330	-	-	-	-	-	-	-	-
bis(2-Chloroethoxy)methane[b]	111-91-1	35	330	-	-	-	-	-	-	-	-
bis(2-Chloroethyl)ether[b]	111-44-4	33	330	-	-	-	-	-	-	-	-
bis(2-Ethylhexyl)phthalate[b]	117-81-7	65	330	-	-	317	3166	-	-	2003	-
4-Bromophenyl phenyl ether[b]	101-55-3	35	330	-	-	212	2125	-	-	1337	-
Caprolactam[b]	105-60-2	44	330	-	-	-	-	-	-	-	-
Carbazole[a]	86-74-8	4	33	-	-	-	-	-	-	-	-
4-Chloroaniline[b]	106-47-8	33	330	-	-	-	-	-	-	-	-
4-Chloro-3-methylphenol[b]	59-50-7	31	330	-	-	-	-	-	-	-	-
2-Chloronaphthalene[b]	91-58-7	32	330	-	-	-	-	-	-	-	-
2-Chlorophenol[b]	95-57-8	28	330	-	-	-	-	-	-	-	-
4-Chlorophenyl phenyl ether[b]	7005-72-3	36	330	-	-	-	-	-	-	-	-
Chrysene[a]	218-01-9	0.202	6.7	-	-	-	-	57.1	384	1008	1704
Dibenz(a,h)anthracene[a]	53-70-3	0.727	6.7	-	-	-	-	6.22	63.4	1946	-
Dibenzofuran[b]	132-64-9	36	330	-	-	41.5	415	-	-	1137	-
3,3'-Dichlorobenzidine[b]	91-94-1	140	1600	-	-	-	-	-	-	-	-
2,4-Dichlorophenol[b]	120-83-2	45	330	-	-	-	-	-	-	-	-
Diethylphthalate[b]	84-66-2	38	330	-	-	56.3	563	-	-	1725	-
2,4-Dimethylphenol[b]	105-67-9	57	330	-	-	-	-	-	-	-	-
Dimethyl phthalate[b]	99-65-0	36	330	-	-	-	-	-	-	-	-

Table G-9. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Semi-Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons in sediment (assuming 1% TOC).

Semi-Volatiles & PAHs (SW-846/8270C & 8310) USEPA CLP TCL - SVOCs	CAS Number	[1]Method Detection Limit (ug/kg, ww)	[1]Reporting Limit (ug/kg, ww)	[2]U. S. EPA SQCs (ug/g, OC)	[2]U. S. EPA SQCs (ug/kg, dw)	[3]Oak Ridge SQBs (ug/g, OC)	[3]Oak Ridge SQBs (ug/kg, dw)	[4]CCME ISQGs (ug/kg, dw)	[5]NOAA ERLs (ug/kg, dw)	[6]Dutch NELs (ug/kg, dw)	[7]SPAH Mixture LC50 (ug/kg, dw)
Di-n-butylphthalate[b]	84-74-2	59	330	-	-	4528	45284	-	-	1363	-
Di-n-octylphthalate[b]	117-84-0	50	330	-	-	-	-	-	-	-	-
4,6-Dinitro-2-Methylphenol[b]	534-52-1	180	1600	-	-	-	-	-	-	-	-
2,4-Dinitrophenol[b]	51-28-5	150	1600	-	-	-	-	-	-	-	-
2,4-Dinitrotoluene[b]	121-14-2	41	330	-	-	-	-	-	-	-	-
2,6-Dinitrotoluene[b]	606-20-2	30	330	-	-	-	-	-	-	-	-
Fluoranthene[a]	206-44-0	0.528	6.7	620	6200	-	-	111	600	982	3240
Fluorene[a]	86-73-7	0.43	6.7	-	-	50.2	502	21.2	19	1003	980
Hexachlorobenzene[b]	118-74-1	41	330	-	-	-	-	-	-	-	-
Hexachlorobutadiene[b]	87-68-3	31	330	-	-	-	-	-	-	-	-
Hexachlorocyclopentadiene[b]	77-47-4	150	1600	-	-	-	-	-	-	-	-
Hexachloroethane[b]	67-72-1	40	330	-	-	141	1410	-	-	1676	-
Indeno(1,2,3-cd)pyrene[a]	193-39-5	0.229	6.7	-	-	-	-	-	-	1990	-
Isophorone[b]	78-59-1	32	330	-	-	-	-	-	-	-	-
2-Methylnaphthalene[a]	91-57-6	2.28	33	-	-	-	-	20.2	70	877	-
Methylphenol[b] (m-Cresol)	108-39-4	160	330	-	-	-	-	-	-	-	-
2-Methylphenol[b] (o-Cresol)	95-48-7	37	330	-	-	1.07	10.7	-	-	1057	-
4-Methylphenol[b] (p-Cresol)	106-44-5	27	330	-	-	-	-	-	-	-	-
Naphthalene[a]	91-20-3	2.12	33	-	-	24.5	245	34.6	160	1134	724
2-Nitroaniline[b]	88-74-4	33	1600	-	-	-	-	-	-	-	-
3-Nitroaniline[b]	99-09-2	33	1600	-	-	-	-	-	-	-	-
4-Nitroaniline[b]	100-01-6	47	1600	-	-	-	-	-	-	-	-
Nitrobenzene[b]	98-95-3	32	330	-	-	-	-	-	-	-	-
2-Nitrophenol[b]	88-75-5	44	330	-	-	-	-	-	-	-	-
4-Nitrophenol[b]	100-02-7	350	1600	-	-	22.6	226	-	-	1240	-
N-Nitro-di-n-propylamine[b]	621-64-7	31	330	-	-	-	-	-	-	-	-
N-Nitrosodiphenylamine[b]	86-30-6	37	330	-	-	116.2	1162	-	-	1575	-
2, 2'-Oxybis(1-chloropropane)	108-60-1	93	330	-	-	-	-	-	-	-	-
Pentachlorophenol[b]	87-86-5	34	330	-	-	-	-	-	-	-	-
Phenanthrene[a]	85-01-8	0.45	6.7	180	1800	-	-	41.9	240	987	3173
Phenol[b]	108-95-2	35	330	3.1	31	-	-	-	-	-	-
Pyrene[a]	129-00-0	0.393	6.7	-	-	-	-	53	665	1014	4103

Table G-9. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Semi-Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons in sediment (assuming 1% TOC).

Semi-Volatiles & PAHs (SW-846/8270C & 8310) USEPA CLP TCL - SVOCs	CAS Number	[1]Method Detection Limit (ug/kg, ww)	[1]Reporting Limit (ug/kg, ww)	[2]U. S. EPA SQCs (ug/g, OC)	[2]U. S. EPA SQCs (ug/kg, dw)	[3]Oak Ridge SQBs (ug/g, OC)	[3]Oak Ridge SQBs (ug/kg, dw)	[4]CCME ISQGs (ug/kg, dw)	[5]NOAA ERLs (ug/kg, dw)	[6]Dutch NELs (ug/kg, dw)	[7]SPAH Mixture LC50 (ug/kg, dw)
2,4,5-Trichlorophenol[b]	95-95-4	69	330	-	-	-	-	-	-	-	-
2,4,6-Trichlorophenol[b]	88-06-2	57	330	-	-	-	-	-	-	-	-

- Benchmarks are not available for this compound.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results.

[2]U. S. EPA (1993b-d). Criteria based on results from eight separate toxicity tests representing the responses of at least at least eight families of aquatic biota

[3]Jones, Suter, and Hull (1997). Benchmarks based on results from at least one toxicity tests representing the responses of at least one species of aquatic biota.

[4]CCME (1999)

[5]NOAA (1999)

[6]Van Leeuwen et al. (1992). Benchmarks based on 19 aquatic species, covering prokaryotes, eukaryotes, invertebrates, and/or vertebrates

[8]Swartz (1999) and Swartz et al. (1995). Benchmarks based on four species of marine and estuarine amphipods

[a]MDL's and RL's based on results achieved by method 8310 (Table: SOLID; SONICATION; Hydrocarbons, Polynuclear Aromatic).

[b]MDL's and RL's based on results achieved by method 8270C (Table: SOLID; SONICATION, Base/Neutrals and Acids).

Table G-10. Method Detection Limits and Reporting Limits compared to Ecological Benchmarks for Inorganics in sediment.

Inorganics USEPA CLP TAL	CAS Number	Method	[1]Method Detection Limit (mg/kg, ww)	[1]Reporting Limits (mg/kg, ww)	[2]U. S. EPA SQCs (mg/kg, dw)	[3]Oak Ridge SQBs (mg/kg, dw)	[4]CCME ISQGs (mg/kg, dw)	[5]NOAA ERLs (mg/kg, dw)
Aluminum	7429-90-5	6010B	1.1	20	-	-	-	-
Antimony	7440-36-0	6010B	0.49	6	-	-	-	-
Arsenic	7440-38-2	6010B Trace	0.3	1	-	-	5.9	8.2
Barium	7440-39-3	6010B	0.13	20	-	-	-	-
Beryllium	7440-41-7	6010B	0.046	0.5	-	-	-	-
Cadmium	7440-43-9	6010B	0.043	0.5	-	-	0.6	1.2
Calcium	7440-70-2	6010B	37	500	-	-	-	-
Chromium	7440-47-3	6010B Trace	0.38	0.5	-	-	37.3	81
Cobalt	7440-48-4	6010B	0.15	5	-	-	-	-
Copper	7440-50-8	6010B	0.27	2.5	-	-	35.7	34
Cyanide	57-12-5	9012A	0.25	0.5	-	-	-	-
Iron	7439-89-6	6010B	6.6	10	-	-	-	-
Lead	7439-92-1	6010B	0.24	10	-	-	-	46.7
Magnesium	7439-95-4	6010B	12	500	-	-	-	-
Manganese	7439-96-5	6010B	0.15	1.5	-	-	-	-
Mercury	7439-97-6	7471A	0.0047	0.1	-	-	0.17	0.15
Nickel	7440-02-0	6010B	0.27	4	-	-	-	20.9
Potassium	7440-09-7	6010B	5.1	500	-	-	-	-
Selenium	7782-49-2	6010B Trace	0.31	0.5	-	-	-	-
Silver	7440-22-4	6010B	0.15	1	-	-	-	1
Sodium	7440-23-5	6010B	50	500	-	-	-	-
Thallium	7440-28-0	6010B	0.5	200	-	-	-	-
Vanadium	7440-62-6	6010B	0.13	5	-	-	-	-
Zinc	7440-66-6	6010B	1.2	2	-	-	123	150

- Benchmarks are not available for this element.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results. (Table: All Analytes: Metals Total Recoverable; Inductively Coupled Plasma (6010B, 6010B Trace); All Analytes: Mercury (7471A, Cold vapor); All Analytes: Cyanide, Total (9012A, Automated))

[2]U. S. EPA (1993b-d). Criteria based on results from eight separate toxicity tests representing the responses of at least at least eight families of aquatic biota.

[3]Jones, Suter, and Hull (1997). Benchmarks based on results from at least one toxicity tests representing the responses of at least one species of aquatic biota.

[4]CCME (1999)

[5]NOAA (1999)

Table G-11. Method Detection Limits, Reporting Limits and Ecological Benchmarks for organisms exposed to Volatile Organic Compounds in soil.

Volatiles (SW-846/8260B, 5035)	CAS Number	[1]Method Detection Limit (ENCORE)	[2]Method Detection Limit (Field Pres.)	[1,2]Reporting Limit	[3]Oak Ridge Toxicological Benchmarks for Earthworms	[2]Oak Ridge Toxicological Benchmarks for Microbes	[3]Oak Ridge Compiled RIVM (Dutch) EIVs	[4]Dutch Soil Cleanup Act B Indicators
USEPA CLP TCL - VOCs		(mg/kg, ww)	(mg/kg, ww)	(mg/kg, ww)	mg/kg	mg/kg	mg/kg	mg/kg
Acetone	67-64-1	0.0018	0.0016	0.02	-	-	-	-
Benzene	71-43-2	0.00063	0.0001	0.005	-	-	-	0.5
Bromodichloromethane	75-27-4	0.00065	0.000079	0.005	-	-	-	-
Bromoform	75-25-2	0.0005	0.00051	0.005	-	-	-	-
Bromomethane	74-83-9	0.0012	0.00013	0.01	-	-	-	-
2-Butanone	78-93-3	0.0048	0.0017	0.02	-	-	-	-
Carbon disulfide	75-15-0	0.0011	0.000083	0.005	-	-	-	-
Carbon tetrachloride	56-23-5	0.00062	0.0001	0.005	-	-	-	-
Chlorobenzene	108-90-7	0.00072	0.00087	0.005	40	-	30	2
Chloroethane	75-00-3	0.00092	0.00019	0.01	-	-	-	-
Chloroform	67-66-3	0.00071	0.000062	0.005	-	-	-	-
Chloromethane	74-87-3	0.00073	0.00066	0.01	-	-	-	-
Cyclohexane	110-82-7	0.0011	0.0002	0.01				
Dibromochloromethane	124-48-1	0.00057	0.00024	0.005	-	-	-	-
1,2-Dibromo-3-chloropropane	96-12-8	0.0031	0.00038	0.01	-	-	-	-
1,2-Dibromoethane	106-93-4	0.00063	0.0018	0.005	-	-	-	-
1,2-Dichlorobenzene	95-50-1	0.00068	0.00099	0.005	-	-	-	-
1,3-Dichlorobenzene	541-73-1	0.0008	0.001	0.005	-	-	-	-
1,4-Dichlorobenzene	106-46-7	0.00064	0.0011	0.005	-	-	30	-
Dichlorodifluoromethane	75-71-8	0.00088	0.00015	0.01	-	-	-	-
1,1-Dichloroethane	75-34-3	0.00063	0.0001	0.005	-	-	-	-
1,2-Dichloroethane	107-06-2	0.00057	0.000088	0.005	-	-	-	-
1,1-Dichloroethene	75-35-4	0.00067	0.0002	0.005	-	-	-	-
cis-1,2-Dichloroethene	156-59-4	0.00027	0.00024	0.025	-	-	-	-
trans-1,2-Dichloroethene	156-60-5	0.0008	0.00021	0.025	-	-	-	-
1,2-Dichloropropane	78-87-5	0.00065	0.00013	0.005	700	-	-	-
cis-1,3-Dichloropropene	10061-01-5	0.00061	0.00046	0.004	-	-	-	-
trans-1,3-Dichloropropene	10061-02-6	0.00059	0.0001	0.004	-	-	-	-
Ethylbenzene	100-41-4	0.00084	0.00099	0.005	-	-	-	5
2-Hexanone	591-78-6	0.0012	0.0014	0.02	-	-	-	-
Isopropylbenzene	98-82-8	0.00067	0.00099	0.005	-	-	-	-
Methyl acetate	79-20-9	0.0025	0.0028	0.01	-	-	-	-
Methylene chloride	75-09-2	0.0014	0.0003	0.005	-	-	-	-
Methylcyclohexane	108-87-2	0.00098	0.00053	0.01	-	-	-	-
4-Methyl-2-pentanone	108-10-1	0.0033	0.00079	0.02	-	-	-	-
Methyl tert-butyl ether	1634-04-4	0.00044	0.000092	0.02	-	-	-	-
Styrene	100-42-5	0.00065	0.001	0.005	-	-	-	5
1,1,2,2-Tetrachloroethane	79-34-5	0.0007	0.00061	0.005	-	-	-	-
Tetrachloroethene	127-18-4	0.00074	0.0007	0.005	-	-	-	-
Toluene	108-88-3	0.00075	0.00067	0.005	-	-	-	3
1,2,4-Trichlorobenzene	120-82-1	0.00087	0.00069	0.005	-	-	30	-

Table G-11. Method Detection Limits, Reporting Limits and Ecological Benchmarks for organisms exposed to Volatile Organic Compounds in soil.

Volatiles (SW-846/8260B, 5035)	CAS Number	[1]Method Detection Limit (ENCORE)	[2]Method Detection Limit (Field Pres.)	[1,2]Reporting Limit	[3]Oak Ridge Toxicological Benchmarks for Earthworms	[2]Oak Ridge Toxicological Benchmarks for Microbes	[3]Oak Ridge Compiled RIVM (Dutch) EIVs	[4]Dutch Soil Cleanup Act B Indicators
USEPA CLP TCL - VOCs		(mg/kg, ww)	(mg/kg, ww)	(mg/kg, ww)	mg/kg	mg/kg	mg/kg	mg/kg
1,1,1-Trichloroethane	71-55-6	0.00071	0.000062	0.005	-	-	-	-
1,1,2-Trichloroethane	79-00-5	0.00054	0.0012	0.005	-	-	-	-
Trichloroethene	79-01-6	0.0007	0.0001	0.005	-	-	-	-
Trichlorofluoromethane	75-69-4	0.0018	0.0001	0.01	-	-	-	-
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.0013	0.0005	0.005	-	-	-	-
Vinyl chloride	75-01-4	0.00066	0.0005	0.01	-	-	-	-
Xylenes	95-47-6	0.002	0.0029	0.005	-	-	-	5

- no benchmark was available for this compound.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results (Table: SOLID, ENCORE; Volatile Organics, GC/MS).

[2]Method Detection Limit and Reporting Limit based on Severn Trent results (Table: SOLID, PURGE and TRAP - Field Preserved Low Level; Volatile Organics, GC/MS).

[3]Efroymson et al. (1997)

[4]Beyer, 1990

Table G-12. Method Detection Limit, Reporting Limits and Ecological Benchmarks for organisms exposed to Semi-Volatile Organic Compounds in soil.

Semi-Volatiles (SW-846/8270C)	CAS Number	[1]Method Detection Limit	[1]Reporting Limit	[3]Oak Ridge Toxicological Benchmarks for Earthworms	[3]Oak Ridge Toxicological Benchmarks for Microbes	[3]Oak Ridge Compiled RIVM (Dutch) EIVs	Dutch Soil Cleanup Act B Indicators
USEPA CLP TCL - SVOCs		(mg/kg, ww)	(mg/kg, ww)	mg/kg	mg/kg	mg/kg	mg/kg
Acenapthene	83-32-9	0.035	0.33	-	-	-	-
Acenaphthylene	208-96-8	0.035	0.33	-	-	-	-
Acetophenone	98-86-2	0.028	0.33	-	-	-	-
Anthracene	120-12-7	0.037	0.33	-	-	-	10
Atrazine	1912-24-9	0.024	0.33	-	-	-	-
Benzaldehyde	100-52-7	0.098	0.33	-	-	-	-
Benzo(a)anthracene	56-55-3	0.035	0.33	-	-	-	-
Benzo(a)pyrene	50-32-8	0.033	0.33	-	-	-	1
Benzo(b)fluoranthene	205-99-2	0.035	0.33	-	-	-	-
Benzo(k)fluoranthene	207-08-9	0.041	0.33	-	-	-	-
Benzo(g,h,i)perylene	191-24-2	0.045	0.33	-	-	-	-
Benzyl butyl phthalate	85-68-7	0.044	0.33	-	-	-	-
1,1'Biphenyl	92-52-4	0.017	0.33	-	-	-	-
bis(2-Chloroethoxy)methane	111-91-1	0.035	0.33	-	-	-	-
bis(2-Chloroethyl)ether	111-44-4	0.033	0.33	-	-	-	-
bis(2-Ethylhexyl)phthalate	117-81-7	0.065	0.33	-	-	-	-
4-Bromophenyl phenyl ether	101-55-3	0.035	0.33	-	-	-	-
Caprolactam	105-60-2	0.044	0.33	-	-	-	-
Carbazole	86-74-8	0.042	0.33	-	-	-	-
4-Chloroaniline	106-47-8	0.033	0.33	-	-	-	-
4-Chloro-3-methylphenol	59-50-7	0.031	0.33	-	-	-	-
2-Chloronaphthalene	91-58-7	0.032	0.33	-	-	-	-
2-Chlorophenol	95-57-8	0.028	0.33	-	-	-	0.5
4-Chlorophenyl phenyl ether	7005-72-3	0.036	0.33	-	-	-	-
Chrysene	218-01-9	0.05	0.33	-	-	-	-
Dibenz(a,h)anthracene	53-70-3	0.038	0.33	-	-	-	-
Dibenzofuran	132-64-9	0.036	0.33	-	-	-	-
3,3'-Dichlorobenzidine	91-94-1	0.14	1.6	-	-	-	-
2,4-Dichlorophenol	120-83-2	0.045	0.33	-	-	-	-
Diethylphthalate	84-66-2	0.038	0.33	-	-	-	-
2,4-Dimethylphenol	105-67-9	0.057	0.33	-	-	-	-
Dimethyl phthalate	99-65-0	0.036	0.33	200	-	-	-
Di-n-butylphthalate	84-74-2	0.059	0.33	-	-	-	-
Di-n-octylphthalate	117-84-0	0.05	0.33	-	-	-	-
4,6-Dinitro-2-Methylphenol	534-52-1	0.18	1.6	-	-	-	-

Table G-12. Method Detection Limit, Reporting Limits and Ecological Benchmarks for organisms exposed to Semi-Volatile Organic Compounds in soil.

Semi-Volatiles (SW-846/8270C)	CAS Number	[1]Method Detection Limit	[1]Reporting Limit	[3]Oak Ridge Toxicological Benchmarks for Earthworms	[3]Oak Ridge Toxicological Benchmarks for Microbes	[3]Oak Ridge Compiled RIVM (Dutch) EIVs	Dutch Soil Cleanup Act B Indicators
USEPA CLP TCL - SVOCs		(mg/kg, ww)	(mg/kg, ww)	mg/kg	mg/kg	mg/kg	mg/kg
2,4-Dinitrophenol	51-28-5	0.15	1.6	-	-	-	-
2,4-Dinitrotoluene	121-14-2	0.041	0.33	-	-	-	-
2,6-Dinitrotoluene	606-20-2	0.03	0.33	-	-	-	-
Fluoranthene	206-44-0	0.038	0.33	-	-	-	10
Fluorene	86-73-7	0.029	0.33	30	-	-	400
Hexachlorobenzene	118-74-1	0.041	0.33	-	1000	30	-
Hexachlorobutadiene	87-68-3	0.031	0.33	-	-	-	-
Hexachlorocyclopentadiene	77-47-4	0.15	1.6	-	-	-	-
Hexachloroethane	67-72-1	0.04	0.33	-	-	-	-
Indeno(1,2,3-cd)pyrene	193-39-5	0.042	0.33	-	-	-	-
Isophorone	78-59-1	0.032	0.33	-	-	-	-
2-Methylnaphthalene	91-57-6	0.033	0.33	-	-	-	-
Methylphenol (m-Cresol)	108-39-4	0.16	0.33	-	-	-	-
2-Methylphenol (o-Cresol)	95-48-7	0.037	0.33	-	-	-	-
4-Methylphenol (p-Cresol)	106-44-5	0.027	0.33	-	-	-	-
Naphthalene	91-20-3	0.035	0.33	-	-	-	5
2-Nitroaniline	88-74-4	0.033	1.6	-	-	-	-
3-Nitroaniline	99-09-2	0.033	1.6	-	-	-	-
4-Nitroaniline	100-01-6	0.047	1.6	-	-	-	-
Nitrobenzene	98-95-3	0.032	0.33	40	-	-	-
2-Nitrophenol	88-75-5	0.044	0.33	-	-	-	-
4-Nitrophenol	100-02-7	0.35	1.6	7	-	-	-
N-Nitro-di-n-propylamine	621-64-7	0.031	0.33	-	-	-	-
N-Nitrosodiphenylamine	86-30-6	0.037	0.33	20	-	-	-
2,2'-Oxybis(1-chloropropane)	108-60-1	0.093	0.33	-	-	-	-
Pentachlorophenol	87-86-5	0.034	0.33	6	400	5	-
Phenanthrene	85-01-8	0.043	0.33	-	-	-	5
Phenol	108-95-2	0.035	0.33	30	100	40	1
Pyrene	129-00-0	0.057	0.33	-	-	-	10
2,4,5-Trichlorphenol	95-95-4	0.069	0.33	9	-	10	-
2,4,6-Trichlorphenol	88-06-2	0.057	0.33	10	-	10	-

- criteria are not available for this compound.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results (Table SOLID; SONICATION; Base/Neutrals and Acids).

[2]Efroymson et al. (1997)

[3]Beyer, 1990

Table G-13. Method Detection Limits and Reporting Limits and Ecological Benchmarks for organisms exposed to Inorganics in soil.

Inorganics USEPA CLP TAL	CAS Number	Method	[1]Method Detection Limit	[1]Reporting Limit	[2]Oak Ridge Toxicological Benchmarks for Earthworms	[2]Oak Ridge Toxicological Benchmarks for Microbes	[2]Oak Ridge Complied RIVM (Dutch) EIVs	[3]Dutch Soil Cleanup Act B Indicators	[4]Geometric Mean Background - Eastern United States
			(mg/kg)	(mg/kg)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	7429-90-5	6010B	1.1	20	-	600	-	-	33,000
Antimony	7440-36-0	6010B	0.49	6	-	-	-	-	0.52
Arsenic	7440-38-2	6010B Trace	0.3	1	-	100	40	30	4.8
Barium	7440-39-3	6010B	0.13	20	-	3000	625	400	290
Beryllium	7440-41-7	6010B	0.046	0.5	-	-	-	-	0.55
Cadmium	7440-43-9	6010B	0.043	0.5	20	20	12	5	-
Calcium	7440-70-2	6010B	37	500	-	-	-	-	3,400
Chromium	7440-47-3	6010B Trace	0.38	0.5	0.4	10	230	250	33
Cobalt	7440-48-4	6010B	0.15	5	-	1000	240	50	5.9
Copper	7440-50-8	6010B	0.27	2.5	60	100	190	100	13
Cyanide	57-12-5	9012A	0.25	0.5	-	-	-	50	-
Iron	7439-89-6	6010B	6.6	10	-	200	-	-	14,000
Lead	7439-92-1	6010B	0.24	10	500	900	290	150	14
Magnesium	7439-95-4	6010B	12	500	-	-	-	-	-
Manganese	7439-96-5	6010B	0.15	1.5	-	100	-	-	260
Mercury	7439-97-6	7471A	0.0047	0.1	0.1	30	10	2	0.081
Nickel	7440-02-0	6010B	0.27	4	200	90	210	100	11
Potassium	7440-09-7	6010B	5.1	500	-	-	-	-	12,000
Selenium	7782-49-2	6010B Trace	0.31	0.5	70	100	-	-	0.3
Silver	7440-22-4	6010B	0.15	1	-	50	-	-	-
Sodium	7440-23-5	6010B	50	500	-	-	-	-	-
Thallium	7440-28-0	6010B	0.5	200	-	-	-	-	-
Vanadium	7440-62-6	6010B	0.13	5	-	-	-	-	43
Zinc	7440-66-6	6010B	1.2	2	200	100	720	500	40

- Benchmarks are not available for this element.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results. (Table: All Analytes: Metals Total Recoverable; Inductively Coupled Plasma (6010B, 6010B Trace); All Analytes: Mercury (7471A, Cold vapor); All Analytes: Cyanide, Total (9012A, Automated))

[2]Efroymson et al. (1997)

[3]Beyer, 1990

[4]Shacklette and Boerngen (1984)

Table G-14. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Polychlorinated Biphenyl Aroclors in water.

PCB (SW-846/8082) USEPA CLP TCL - PCBs	CAS Number	[1]Method Detection Limit (ug/L)	[1]Reporting Limit (ug/L)	[2,a]Oak Ridge FCV (ug/L)	[2,b]Oak Ridge LCV (ug/L)	[2,b]Oak Ridge Teir II SCV (ug/L)	[3]CCME EQGs (ug/L)	[4]U. S. EPA NAWQC CCC (ug/L)	[2,c]Oak Ridge Population EC20 (ug/L)
Aroclor 1016	12674-11-2	0.018	1.0	-	-	-	-	-	-
Aroclor 1221	11104-28-2	0.094	1.0	-	60	0.28	-	-	10
Aroclor 1232	11141-16-5	0.16	1.0	-	124	0.58	-	-	16
Aroclor 1242	53469-21-9	0.3	1.0	-	4.9	0.053	-	-	1.58
Aroclor 1248	12672-29-6	0.22	1.0	-	-	0.081	-	-	1.26
Aroclor 1254	11097-69-1	0.096	1.0	-	0.1	0.033	-	-	0.63
Aroclor 1260	11096-82-5	0.065	1.0	-	2.3	94	-	-	316

- Benchmarks are not available for this compound.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results (Table: Q: Aroclors Only Standard List; PCBs (8082))

[2]Suter and Tsao (1996).

[a]Benchmark based on results from at least three separate toxicity tests representing the responses of at least three families of aquatic biota

[b]Benchmark based on results from at least one toxicity study representing the responses of at least one species

[c]Benchmark based on results from largemouth bass, only.

[3]CCME (1999)

[4]U. S. EPA (1999b). Criteria based on results from eight separate toxicity tests representing the responses of at least at least eight families of aquatic biota

Table G-15. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Polychlorinated Biphenyl Aroclors in sediment (assuming 1% TOC).

PCB (SW-846/8082) USEPA CLP TCL - PCBs	CAS Number	[6]log Koc	[1]Method Detection Limit (ug/kg, ww)	[1]Reporting Limit (ug/kg, ww)	[2]U. S. EPA SQCs (ug/g, OC)	[2]U. S. EPA SQCs (ug/kg, dw)	[3]Oak Ridge SQBs (ug/g, OC)	[3]Oak Ridge SQBs (ug/kg, dw)	[4]CCME ISQGs (ug/kg, dw)	[5]NOAA ERLs (ug/kg, dw)
Aroclor 1016	12674-11-2	NA	5.3	33	-	-	-	-	-	-
Aroclor 1221	11104-28-2	4.62	19	33	-	-	12	117	-	-
Aroclor 1232	11141-16-5	5.01	11	33	-	-	59	594	-	-
Aroclor 1242	53469-21-9	5.51	18	33	-	-	17	172	-	-
Aroclor 1248	12672-29-6	6.09	4.6	33	-	-	100	997	-	-
Aroclor 1254	11097-69-1	6.39	20	33	-	-	81	810	60	-
Aroclor 1260	11096-82-5	6.68	7.4	33	-	-	449,912	4,499,123	-	-

- benchmarks were not available for this compound.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results (Table: Q: Aroclors Only Standard List; PCBs (8082))

[2]U. S. EPA (1993b-d). Criteria based on results from eight separate toxicity tests representing the responses of at least at least eight families of aquatic biota

[3]Jones, Suter, and Hull (1997). Benchmarks based on results from at least one toxicity tests representing the responses of at least one species of aquatic biota.

[4]CCME (1999)

[5]NOAA (1999)

[6]ATSDR (1989)

Table G-16. Method Detection Limits, Reporting Limits and Ecological Benchmarks for Polychlorinated Biphenyl Aroclors in soil.

PCB (SW-846/8082) USEPA CLP TCL - PCBs	CAS Number	[1]Method Detection Limit (mg/kg, ww)	[1]Reporting Limit (mg/kg, ww)	[2]Oak Ridge Toxicological Benchmarks for Earthworms mg/kg	[2]Oak Ridge Toxicological Benchmarks for Microbes mg/kg	[2]Oak Ridge Compiled RIVM (Dutch) EIVs mg/kg	[3]Dutch Soil Cleanup Act B Indicators (Total PCBs= 1 ppm) mg/kg
Aroclor 1016	12674-11-2	0.015	0.033	-	-	-	-
Aroclor 1221	11104-28-2	0.019	0.033	-	-	-	-
Aroclor 1232	11141-16-5	0.02	0.033	-	-	-	-
Aroclor 1242	53469-21-9	0.024	0.033	-	-	-	-
Aroclor 1248	12672-29-6	0.0081	0.033	-	-	-	-
Aroclor 1254	11097-69-1	0.02	0.033	-	-	-	-
Aroclor 1260	11096-82-5	0.014	0.033	-	-	-	-

- Benchmarks are not available for this element.

[1]Method Detection Limit and Reporting Limit based on Severn Trent results (Table: Q: Aroclors Only Standard List; PCBs (8082))

[2]Efroymson et al. (1997)

[3]Beyer, 1990